LITIGATION TECHNICAL SUPPC

ROCKY MOUNTAIN A

FINAL TECHNICAL PLAN
PHASE I - VOLUME I
VERSION 3.2

November 1987
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TASK NO. 24
PROGRAM FOR ARMY SPILL SITES

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U.S. ARMY PROGRAM MANAGER'S OFFICE FOR
ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP

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13. ABSTRACT *(Maximum 200 words)*

THIS FINAL TECHNICAL PLAN DESCRIBES THE WORK THAT WILL BE UNDERTAKEN TO PROVIDE TECHNICAL SERVICES NECESSARY TO CONDUCT A TYPICAL PHASE I PROGRAM IN AREAS IDENTIFIED AS ARMY SPILL SITES (SECTIONS 1 AND 2).

THE OVERALL OBJECTIVE OF TASK 24 IS TO ASSESS THE NATURE AND EXTENT OF CONTAMINATION IN THE UNSATURATED ZONE IN AREAS REPORTED TO BE ARMY SPILL SITES AND IN SELECTED STRUCTURES WHERE PHYSICAL INVENTORIES WILL BE DEVELOPED. AN EXPLORATORY SURVEY PROVIDING GEOTECHNICAL AND CHEMICAL INFORMATION WILL BE USED TO:

1. IDENTIFY THE POSSIBLE CONTAMINANTS IN THE SOIL AT EACH SITE
2. PROVIDE THE BASIS FOR AN ESTIMATE OF THE VOLUME OF CONTAMINATED MATERIAL PRESENT
3. PROVIDE A BASIS FOR THE DESIGN OF A PHASE II PROGRAM LEADING TO A REMEDIAL PLAN
4. PROVIDE LITIGATION SUPPORT AND APPORTION CLEANUP COSTS BETWEEN THE ARMY

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TASK 24 TECHNICAL PLAN
VOLUME I -- SPILLS
TABLE OF CONTENTS

Section Page

TASK 24 TECHNICAL PLAN
VOLUME I -- SPILLS
LIST OF FIGURES

TASK 24 TECHNICAL PLAN
VOLUME I -- SPILLS
LIST OF FIGURES (Continued)

TASK 24 TECHNICAL PLAN
VOLUME I -- SPILLS
LIST OF TABLES

TASK 24 TECHNICAL PLAN
VOLUME I -- SPILLS

ABBREVIATIONS

AA	Atomic Absorption
BIM	Basic Information Map
CAL	California Analytical Laboratories
CFR	Code of Federal Regulations
CIP	Cast Iron Pipe
CRZ	Contaminant Reduction Zone
DAR	Damage Assessment Report
DBCP	Dibromochloropropane
Ebasco	Ebasco Services Incorporated
EPA	Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FIS	Facility Information Sheet
ft	Feet
ft^2	Square Feet
g	Gram
gal.	Gallon
GB	Methylisopropoxyfluoro-phosphine oxide [$CH_3(FPO)OC_3H_7$]
GC/MS	Gas Chromatography/Mass Spectrometry
GFD	Geotechnical Field Drilling
gpm	Gallons Per Minute
HASP	Health and Safety Program
H&S	Health and Safety
in.	Inch
ICP	Inductively Coupled Argon Plasma Spectroscopy
IR-DMS	Installation Restoration - Data Management Systems
MKE	Morrison-Knudsen Engineers
ml	Milliliter
MRI	Midwest Research Institute
MS	Mass Spectroscopy
N	Normality, Normal
NBS	National Bureau of Standards

ABBREVIATIONS (Continued)

NIH	National Institute of Health
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PMO	Program Manager's Office for the RMA Contamination Cleanup
ppb	Parts Per Billion
ppm	Parts Per Million
PPLV	Preliminary Pollutant Limit Values
psi	Pounds Per Square Inch
PWS	Process Water System
QA	Quality Assurance
QC	Quality Control
RMA	Rocky Mountain Arsenal
RT	Retention Time
Shell	Shell Chemical Company
SI	International Standard Units (Systeme Internationale)
STB	Super Tropical Bleach
USAMBRDL	U.S. Army Medical Bioengineering Research and Development Laboratory
USATHAMA	U.S. Army Toxic and Hazardous Materiels Agency
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VC	Vitrified Clay
yd^3	Cubic Yards
ug	Microgram

1.0 INTRODUCTION

1.1 BACKGROUND

The Program Manager's Office for the Rocky Mountain Arsenal Contamination Cleanup is overseeing efforts by two contractor teams to identify the nature and extent of contamination at selected sites on the Rocky Mountain Arsenal. The two volumes of this Technical Plan describe the work that the contractor team headed by Ebasco Services Incorporated will undertake to provide technical services necessary to conduct a typical Phase I program in areas identified as Army spill sites (Volume I - Spills) and to conduct a modified Phase I contamination survey on selected structures at RMA (Volume II - Structures). This work has been awarded as Task Order Number 24.

This plan is one of a series that has been proposed by Ebasco to describe its planned activities at the RMA. Ebasco's Final Technical Plan for Task 2, South Plants, (Ebasco, 1985a/RIC 87006R01) was the first of these plans and serves as a reference document for all plans subsequently generated. The South Plants Technical Plan (Task 2) contains detailed background information on the general contamination problems at RMA, and is referenced to avoid repetition of this general background information.

1.2 TECHNICAL APPROACH

The overall objectives of Task 24 are to assess the nature and extent of contamination in:

- o The unsaturated soil zone in areas reported to be Army spill sites, and
- o Selected structures at RMA, where physical inventories will be developed.

The first objective listed above will be addressed in the Task 24 Technical Plan, Volume I - Spills, and the second objective will be addressed in Volume II - Structures.

1.2.1 Specific Program Objectives

The Phase I program for Army spill sites will be conducted in a manner similar to previous Phase I studies. In conjunction with Phases I and II of the South Plants Regional Study and the Shell Spill Sites Study, the Phase I program for the Army spill sites under Task 24 should provide sufficient information to perform a quantitative contamination assessment capable of adequately defining remedial action concepts.

The Task 24 (Spills) Phase I program will consist of an exploratory survey providing geotechnical and chemical information that will be used to:

- Identify the possible contaminants in the soils at each reported site;
- Provide the basis for an estimate of the volume of contaminated material present at each site;
- Provide a basis for the design of a quantitative Phase II contamination assessment leading to a plan of remedial action for each contaminated site; and
- Provide litigation support to apportion cleanup costs between the U.S. Army and Shell Chemical Company.

No water sampling is planned because groundwater contamination will be addressed under the Phase I program in other Tasks. See Ebasco's Final Technical Plan for Task 2, South Plants, for further details (Ebasco, 1985a/RIC 87006R01).

1.2.2 Boring Location Criteria

Soil sampling within the areas reported to be Army spill sites will conform with the procedures established for Tasks 1 and 2. In general, boring densities and sampling intervals will be consistent with the guidelines developed for Tasks 1 and 2.

To obtain the boring density for the Army spill sites, originally planned in context with the South Plants Regional Study (Ebasco, 1986e), the entire South Plants area was gridded according to the criteria contained in the South Plants (Task 2) Technical Plan (Ebasco, 1985a/RIC 87006R01). The curve in Figure 24-1, which relates the boring spacing (in feet) to the total study area (in square feet), was developed empirically by members of the Ebasco and ESE teams. For an overall unexamined area of 4,500,000 ft^2 within South Plants, and a grid spacing of approximately 145 ft (from the curve), 210 borings would be required to meet the criterion for boring density established in the Task 2 Technical Plan. Of these, 53 borings (25 percent) would be drilled for sampling in Phase I of the South Plants Regional Study. This split is in accordance with the criterion of 25 percent of the borings to be drilled in Phase I and 75 percent to be drilled in Phase II established for areas greater than 1,000,000 ft^2 in the Task 2 Technical Plan.

As the Army spill sites are within the area of the South Plants Regional Study, the basic grid and spacing of the South Plants Regional Study was utilized as a starting point for locating borings for the Task 24 Army spill sites. Also, a general criterion of at least one boring, but no more than three borings, was utilized to determine the number of borings planned for each individual spill site that would be investigated under Task 24. However, these general criteria were modified as appropriate to provide coverage, coordinate with other Phase I soil boring programs under Task 2 and Task 7, and provide adequate information to meet the overall Army spill sites program objectives. See Section 3.0 for specific information on the planned boring densities for each spill site.

The vertical soil sampling intervals will be consistent with the intervals established in the Task 2 Technical Plan. The standard planned intervals are 0 to 1 ft, 4 to 5 ft, 9 to 10 ft, 14 to 15 ft, 19 to 20 ft, and at 10 ft intervals thereafter (if necessary). Additional intervals will be sampled if the field geologist notes visual evidence which indicates the likelihood of contamination in soil not covered by the standard intervals. Except as discussed in Section 3.0, at least one boring at each spill site will be

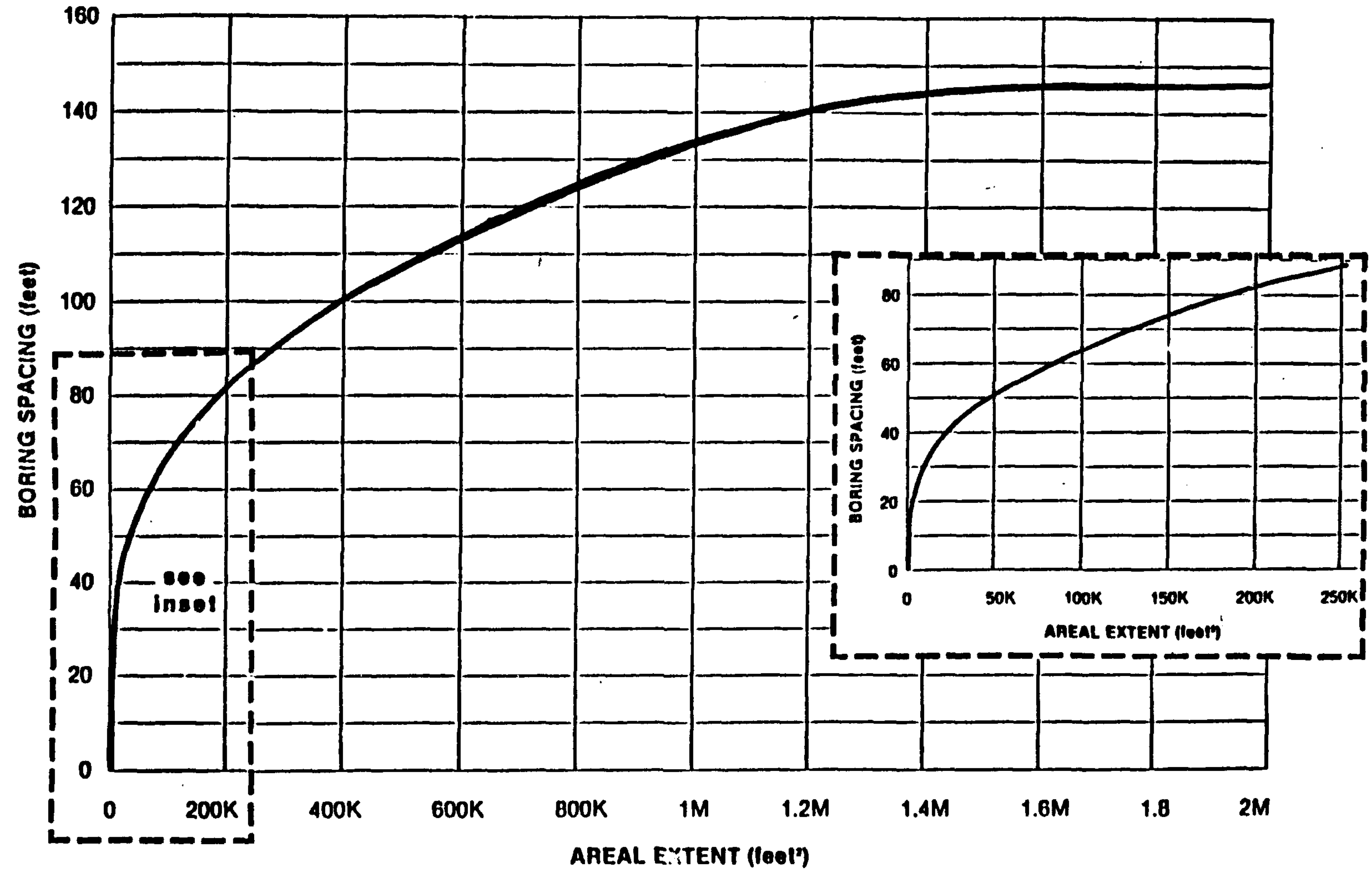


FIGURE 24-1

EMPIRICAL CURVE TO DETERMINE BORING SPACINGS BASED ON AREAL EXTENT OF SITES

drilled to the water table. At the Army spill sites being investigated under Task 24 (Spills), the maximum depth from ground surface to the water table is generally expected to be 20 ft.

1.2.3 General Methods

Polybutyrate tube cores will be taken with hollow stem auger drilling equipment. Core samples will be collected and logged, and will be sealed with Teflon caps. Collected samples will be sent to Ebasco's project laboratories for chemical analysis.

Special monitoring procedures will be utilized during drilling in areas of potential Army agent contamination to determine if drilling equipment (e.g., augers and core barrels) has been contaminated with agents. In particular, metals contaminated with mustard will not be reused for the Remedial Investigation Program, and will be handled and disposed according to PMO instructions.

Monitoring for Army agent contamination will begin on-site immediately after polybutyrate cores have been retrieved from the augers. After sealing the 1 ft sample, 6 in. of soil will be removed from each end of the remaining 4 ft core and placed into an empty 1 ft polybutyrate tube. The newly filled polybutyrate tube will then be placed in a specially designed heater which raises the temperature of the soil to approximately 40° C for at least 15 minutes; this is sufficient to volatilize Army agents. Off-gases are tested for the presence of Army agent during this heating period using an Army M18A2 monitoring device. If results of the monitoring are negative, cores will be logged and stored, and the drilling equipment will be decontaminated and removed from the site. If the results are positive, no samples will be shipped, and no drilling equipment that may have come into contact with the Army agents will be removed from the site until further instructions from PMO are received.

Prior to shipment to Ebasco's project laboratories, samples collected in possible Army agent contaminated areas will be screened by the RMA laboratory. If no Army agents are detected by the RMA laboratory, the samples will be shipped to the project laboratories for chemical analysis. If the RMA laboratory results are positive for Army agents, samples will not be shipped, and no equipment that may have come into contact with the agents will be removed from the site.

In areas where nonvolatile components reportedly have leaked, samples will be gathered through trenching rather than augering, using a composite type trenching program. This program will involve digging a 6 in. trench, approximately 4 in. wide and 20 ft long, beneath overhead transfer lines that may have leaked. A stainless steel hand trowel will be used to excavate the trenches. Soil from the 6 in. depth will be collected from the entire length of each trench. A single composite sample from each 20 ft trench will be placed into cleaned Mason jars with Teflon cap liners. The sample jars containing the composite samples will be sent to the laboratory to be analyzed in the same manner as the other soil samples.

Samples will be analyzed for two major categories of Phase I analytes -- the standard suite of substances such as volatile organics, semivolatile organics, ICP metals, arsenic, and mercury; and Army agent degradation products such as thiodiglycol, isopropylmethyl phosphonate, organoarsenic, and organomercury. The choice of analyses for samples at a particular spill site will be based on the nature of the substances reportedly used or spilled at that site, as identified through the literature search.

1.2.4 Phase II

Based upon the number of bores and samples being analyzed within the South Plants area under various tasks and studies, a Phase II study under Task 24 (Spills) is currently not anticipated. However, if the results of the Task 24 (Spills) study indicate a need for further study, the Phase I results will be used to develop a Phase II program, which will be part of a subsequent task. Based upon these and other considerations, final remedial action will be recommended.

1.3 SITES TO BE INVESTIGATED UNDER TASK 24

1.3.1 Location and Description of Sites

The locations of Army spill sites to be investigated under Task 24 are shown on Figure 24-2 (see map pocket at back of Technical Plan) and are listed in Table 24-1. The spill areas described in this section were originally identified in a letter dated May 1985 by Shell Chemical Company to the Army; 29 existing or potential spill areas for which Shell had information were listed in an attachment to the letter. Since the Shell letter was written, additional research has been conducted by Ebasco on the nature and location of spills in the South Plants area. The reported spill areas described below include areas identified in the Shell letter and the others researched after the Shell letter was written. All of these sites will be investigated under Task 24 (Spills).

1.3.2 Numbering/Designation System for Army Spill Sites

For the 29 potential sites originally listed in the Shell letter (Spills 1-29), the original numbering system assigned by Shell has been retained. For additional areas that tentatively have been identified for further research or for Phase I study, the numbering system has been continued in sequence. If sites are removed from the Phase I study program, their numbers will be retained, and the disposition of study of that site will be reported to ensure that no sites are dropped accidentally from further consideration. If research uncovers additional areas that should be investigated under Task 24 (Spills), they will be listed at the end of the spill area list and will be numbered in sequence.

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills).

Army Spill Site No.	Location	Description of Spill
1	Section 1; north of Building 511.	Toluene spill (late 1950s).
2	Section 1; Building 513 and unlined basins north of Building 512.	M-1 (lewisite) disposal.
3	Section 1; lewisite reactor rooms of Buildings 511 and 514.	Arsenic trichloride, mercury, and mercuric chloride spills.
4	Section 1; behind Building 512.	Mercury spill (not verified).
5	Section 1; lewisite production area (includes Buildings 511, 512, 514, 515, and 516 and surrounding areas).	Mercuric chloride, arsenic oxide, acetylene, and lewisite lost through tank/pipe leaks.
6	Section 1; an area west Buildings 536 and 537.	lewisite spills (not verified).
7	Section 1; northeast of Building 536 and south of Building 537.	Mustard leaks from one-ton containers stored in an unpaved area (mid-1950s).
8	Section 1; area between Building 514 and 529.	Possible mustard breakdown products encountered by Shell during installation of a sump tank in the 1980s.
9	Section 1; area south of Buildi [illegible] 732.	Diesel fuel spill due to tank overfilling on December 18, 1975.
10	Section 1; Building 753.	Pesticides and herbicides stored by Shell (no spills reported).

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills) -- continued.

Page 2 of 6 pages

Army Spill Site No.	Location	Description of Spill
11	Section 1; near Building 471.	Chlorobenzene (unknown quantity).
12	Section 1; holding pits outside of Building 522; M-1 settling ponds (Army Spill Site No. 2); Building 514 (SO_2 disposal plant).	Lime sludge from the acetylene generators.
13	Section 1; arsenic trioxide storage silos 523C, 523D, 523E, 523F, 523G, and associated conveyance and loading areas.	Arsenic trioxide dust leaks from silos, conveyors, and hoses.
14	Section 1; mustard decontamination pits, Buildings 417 and 427.	Incompletely neutralized unacceptable or wild batches of mustard in decon pits.
15	Section 1; decontamination pit near the southeast corner of Building 514.	Contaminated mustard wash water (containing soluble iron, sulfur compounds, and mustard).
16	Section 1; laundry and clothing treatment facility (Building 314), unlined surface ditch east of Building 314.	Wash and decon water and impregnation solutions containing trichloroethylene, solutions of chlorinated paraffin octachlorocarbonilide, and octachlorocarbonilide and zinc oxide.
17	Section 1; Building 313 and open ditch east of Building 313.	Laboratory sink drainage/ wastewater disposal.

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills) -- continued.

Army Spill Site No.	Location	Description of Spill
18	Section 1; areas in and around the maintenance shops (Buildings 533 and 534).	Small spills of petroleum products, paints, thinners, and solvents.
19	Section 1; areas in and around the heavy industrial equipment renovation facilities in Building 751.	Small spills of organochlorine compounds, degreasing solvents, paint strippers, rust removers, paints, thinners, and other solvents.
20	Section 1; flow from caustic tank east of Building 536 into drainage ditch west of the tank.	Leak of unknown liquid. November 16, 1981.
21	Spill number listed in Shell letter (May 1985), but no location given.	No site description in Shell Letter (May 1985); unknown spill.
22	Section 1; Building 537 (mustard thaw and unloading area).	1,200 lb mustard spill (1971); 1,200 lb total spills of mustard to drains.
23	Spill number listed in Shell letter (May 1985), but no location given.	No site description in Shell letter (May 1985); unknown spill.
24	Section 1; in and near Building 534.	Mercury spills, 1969-1978, during Orsate gas sampling of acetylene.
25	Section 1; drainage ditch north of Building 541.	"Phossy water" wastes from white phosphorus cup filling operations, diverted to a ditch north of Building 541 to minimize the explosion hazard in the building.

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills) -- continued.

Army Spill Site No.	Location	Description of Spill
26	Section 2; phosgene bomb filling facilities, Buildings 331 and 332.	Phosgene leaks from bombs during operation of phosgene bomb filling plant, 1944.
27	Section 2; drains in Buildings 362 and 365.	Several spills of lead azide to drains.
28	Section 2; drains in and beneath Buildings 362 and 365.	Several spills of red phosphorus to drains
29	Section 1; former settling basin now beneath Building 523.	Arsenic sludge from the arsenic trichloride reactor washdown, discharged to an external settling basin (later covered in an expansion of Building 523).
30	Section 2; adjacent to Building 252.	Release of approximately 3,700 lbs of chlorine (reportedly in gaseous form) on March 31, 1952, when an Army operated train engine pushed two cars into a chlorine tank car being loaded onto a track scale.
31	Sections 1 & 2; along railroad sidings.	Chemicals possibly spilled from tank cars due to leaky exit valves.
32	Section 1; near the hydrazine facility.	Water used to flush hydrazine drums ran onto the ground (about 50 drums per month were flushed during the late 1960s to mid 1970s).

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills) -- continued.

Army Spill Site No.	Location	Description of Spill
33	Section 1; Building 543, instrument laboratory.	Mercury spill in lab on March 1, 1983; was cleaned up.
34	Section 1; southeast portion of Building 543.	Explosion at mouth of charging hopper of acetylene generating unit no. 4; March 30, 1943.
35	Section 25; Building 1501.	Uncontrolled release of "relatively large quantity" of GB, which was neutralized with caustic; neutralized GB mixed with caustic was disposed into 55 gal. drums; occurred April 19, 1953.
36	Section 25; North Plants area (near Building 1501).	Spill of hydrofluoric acid in Building 1501; other spills may have occurred in and near the building.
37	Section 1; ditch beginning of SE corner of Building 742.	Spill of concentrated mixed acid (sulfuric and nitric) neutralized near the ditch head with sodium hydroxide.
38	Section 2, salt storage pad.	Storage of inactive salts (1943-1945), and GB brine (1956-1965).
39	Section 1; within Building 537.	Spill of about 500 gallons of mercury catalyst during the late 1940s.

Table 24-1. Rocky Mountain Arsenal Army Spill Sites to be Investigated in Task 24 (Spills) -- continued.

Army Spill Site No.	Location	Description of Spill
40	Section 1; between Building 512 and 514.	Leaks of distilled mustard gas during transfer of materials between tanks (1945, 1946).
41	Section 2; chlorine plant (locations to be determined).	Leaks of spent acid.

2.0 EVALUATION OF BACKGROUND DATA

2.1 DATA COMPILATION FOR ARMY SPILL SITES

2.1.1 Literature Review

A preliminary literature review has been conducted, and continuing research is planned prior to and during commencement of any field work. The literature review will result in an annotated list of spill sites, including pertinent information about the type and volume of potential contamination and the locations of spills.

Detailed maps showing spill locations were developed from information gathered during the preliminary literature review. These maps were utilized by the field crews during their initial reconnaissance to identify the areas potentially affected by the spills.

2.1.2 Initial Site Reconnaissance

An initial site reconnaissance was performed after the literature review, prior to the commencement of field work, so that the possible spill locations under investigation in this task could be further clarified. The maps showing spill locations will be updated as necessary prior to the commencement of onsite activities.

2.2 DETERMINATION OF TENTATIVE SPILL SITE BOUNDARIES

Boundaries for the spill sites that will be investigated under Task 24 (Spills) were tentatively determined from preliminary literature searches and field reconnaissance. These boundaries have been established to provide a basis for project planning and a working area for onsite investigations only; they do not necessarily represent the areal extent of potential contamination at individual spill sites.

3.0 FIELD INVESTIGATION PROGRAM

3.1 INTRODUCTION TO THE ARMY SPILL SITE SAMPLING PROGRAM

The spill sites sampling program will be a typical Phase I study. Sampling procedures will be similar to those developed for other Phase I studies at RMA. See Section 1.0 for the criteria utilized to locate borings and sampling intervals.

3.2 SOIL BORING PROGRAM FOR ARMY SPILL SITES

This portion of the Technical Plan presents source-specific information, including results of previous geotechnical studies, disposal history, suspected contaminants present, number of planned borings, and planned types and numbers of samples. Tentative borehole locations for the entire area being studied under Task 24 (Spills) are shown on Figure 24-2 (see map pocket). The number, depth, and exact location of Task 24 (Spills) borings may be altered as a result of research, field reconnaissance, or detection of buried objects.

3.2.1 Sites to be Investigated

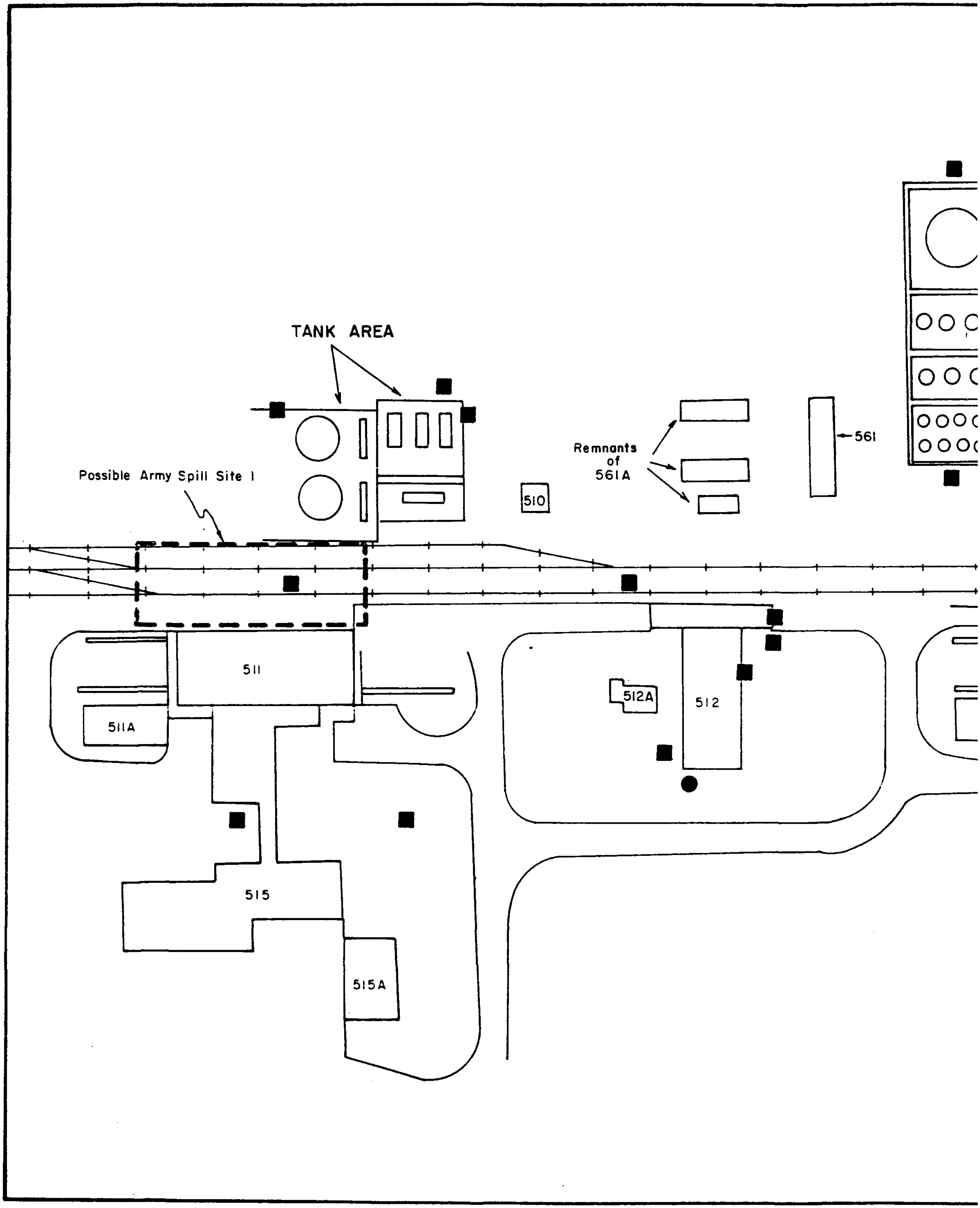
Spill sites were initially identified through a literature search (see Section 1.0). Documentation developed through the literature search was used to verify spill locations and reconstruct spill scenarios. Each spill location has also been inspected in the field by Ebasco staff, who noted additional information that could be helpful in determining locations of possible contaminants, and thus in determining locations for Phase I borings. Indicators of possible contaminants include ground stains, stressed vegetation, mounded materials, loading areas, filler and transport pipes, tanks, pits, standing liquid, ditches, depressions, excavations, and other disturbed areas. This information was combined with the documentation and the general location and spacing criteria to develop a soil boring program for the spill sites.

A description of each site and of the Phase I program planned for each site follows. Table 24-2 (following the individual spill site descriptions) summarizes the site descriptions, the numbers of borings at each site, the number of samples to be taken, and the planned laboratory analyses for the samples.

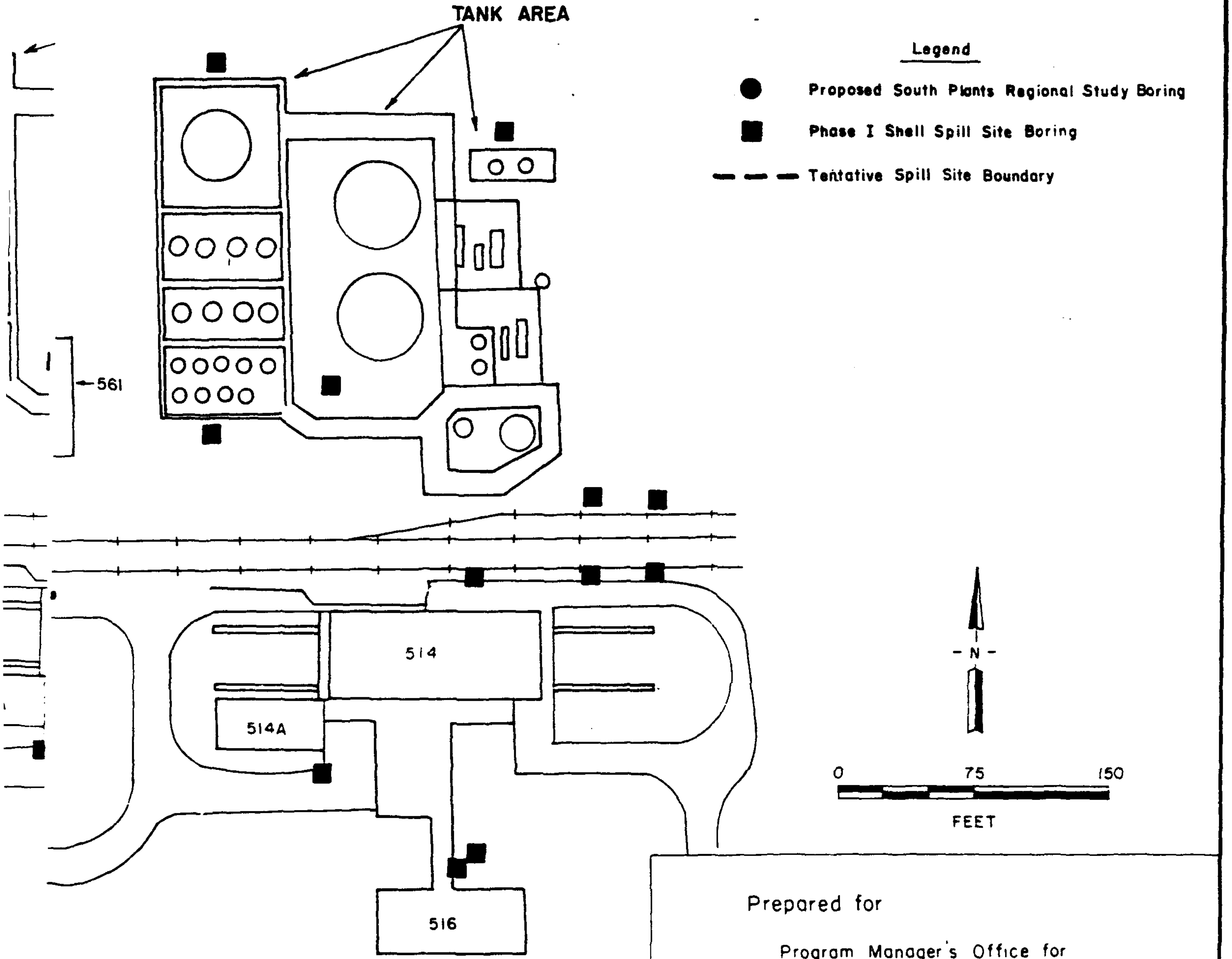
Spill Site No. 1:

Between 1957 and 1959, toluene was spilled on the ground north of Building 511 (Shell, 1985). The spill involved approximately 5 gal. of toluene, and the spill covered an area of approximately 10 ft^2. The RMA Fire Department responded to the incident and covered the affected area with water (Gerton, 1985). The spill was caused by an accident involving a tank car of Shell toluene and a switch engine (Kuznear & Trautmann, 1980; RMA, 1945a).

Because a Task 2 boring (Phase I) was drilled at this location (Figure 24-3), no additional borings are planned under Task 24 (Spills). No volatile or semivolatile target analytes were detected in samples taken from the Task 2 Phase I boring.



TANK AREA
Possible Army Spill Site 1
510
Remnants of 561A
561
511
511A
512A
512
515
515A



See Figure 24-2 for Vicinity Map

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Aberdeen Proving Ground, Maryland

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FIGURE 24-3

Army Spill Site 1, Section 1
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 2:

The lewisite disposal facility reportedly was operational between April and November 1943. The facility was located south of December 7 Avenue, north of the east-west railroad line, in the yard north of present-day Building 561 (see Figure 24-2). It included four disposal reactors (Building 513) (10 ft long by 10 ft wide by 10 ft high) and three 300,000-gallon unlined settling basins. These settling basins were known as the "M-1 basins." The dimensions of the M-1 basins were 75 ft wide by 100 ft long by approximately 5 ft deep (Whitman, 1942). These subsurface disposal pits are now covered with fill material and new structures, as no surface evidence of their location has been found.

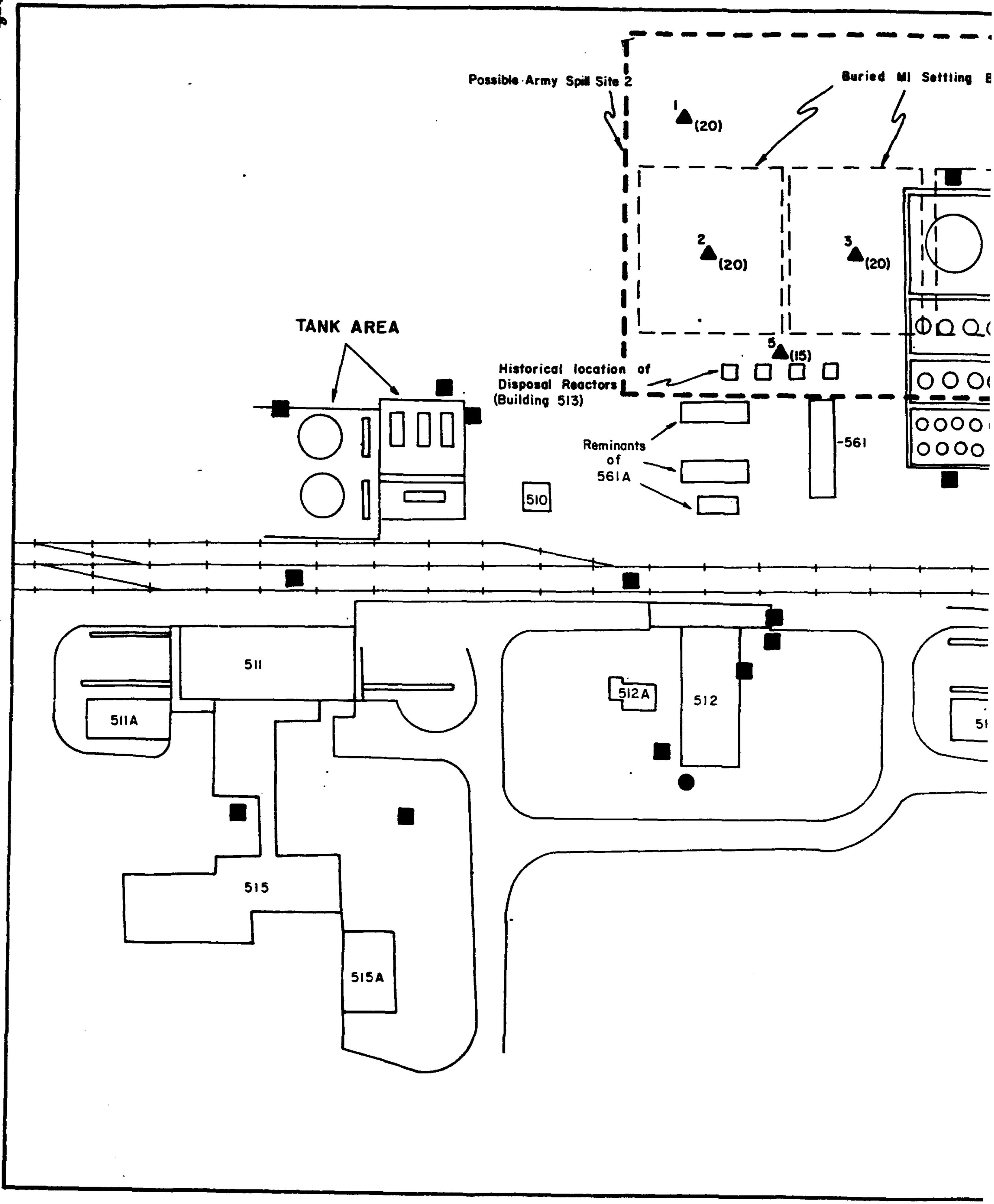
Numerous spills alleged to have occurred within the buildings in the lewisite complex, the acetylene plant, the thionylchloride plant, and the arsenic trichloride plant were routed to the M-1 basins through floor drains and connecting piping. Wastes from the lewisite complex (Buildings 512 and 514), the acetylene plant (Buildings 518, 519, 521, 522, 522A, and 525), the thionyl chloride plant (Buildings 471, 472, 473, and 475), and the arsenic trichloride plant (Buildings 523, 523A, 523B, 523C, and 524) were allegedly held in these basins prior to disposal elsewhere (Shell, 1985).

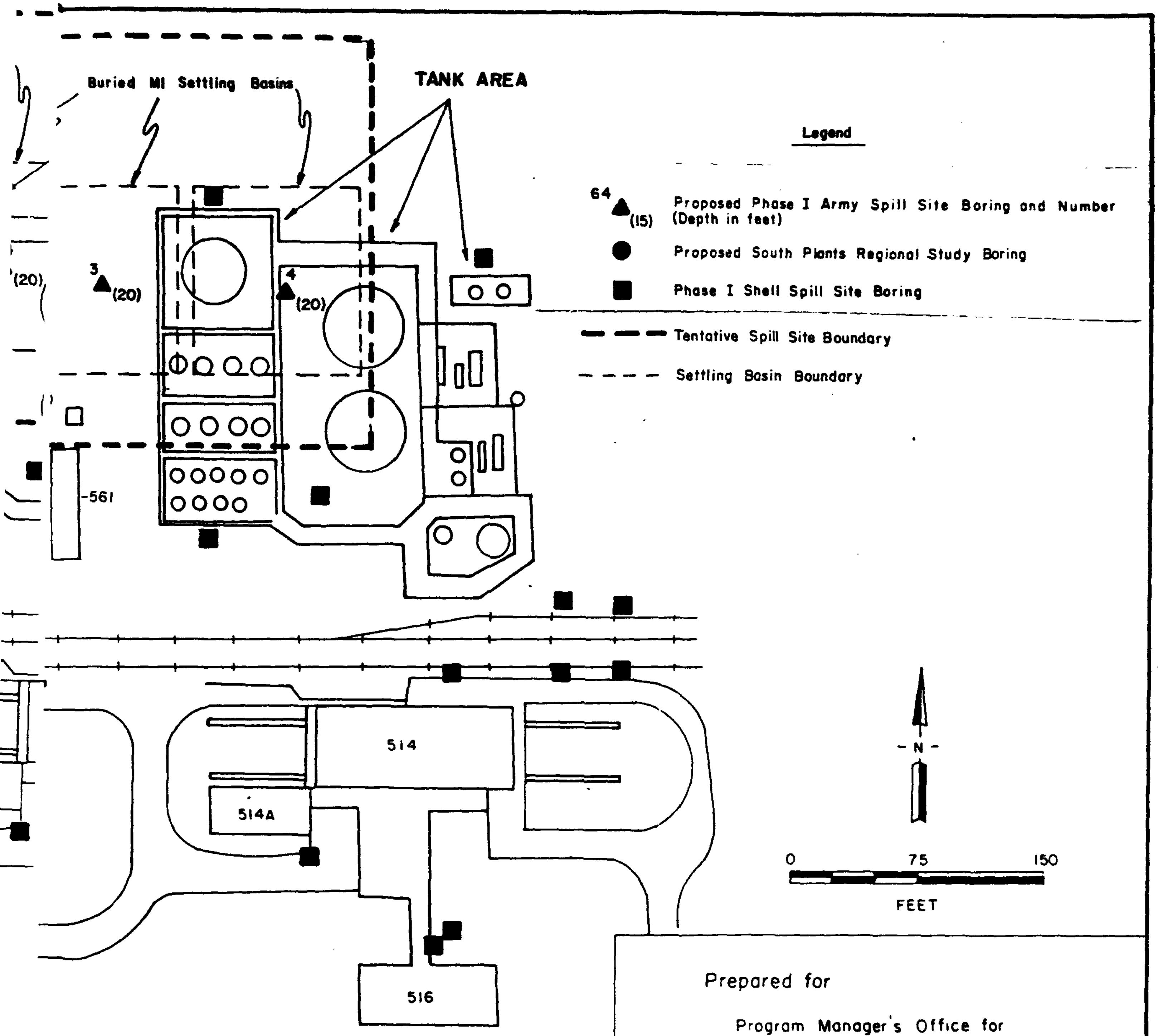
As wastes entered the disposal facility, they reportedly were agitated in the four reactors and neutralized with lime. After neutralization, the wastes were sent through troughs to the M-1 basins to settle. The liquid from the settling basins was decanted through an 18 in. overflow pipe to 3 pits in Section 36 (Site 36-4) where the effluent was treated with lime before being discharged to Basin A (Site 36-1)(Plan No. 7164-2030, 1943; map no. 18-02-01, 1957; Donnelly, 1943; Donnelly, 1959; Ackerman, 1960; RMA, 1945b).

A total of 5 borings are proposed to investigate the lewisite disposal facility (see Figure 24-4). One boring in each of the three M-1 basins (Borings 2, 3, and 4) will be drilled to the water table (anticipated to be at 20 ft below the ground surface). For these 3 borings, samples will be taken at the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. Another boring (Boring 1) will also be drilled to the water table; it will be placed north (downgradient) of one of the settling basins (see Figure 24-4) to detect whether leakage from the basins may have occurred. Samples will be taken from this boring at the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. One boring (Boring 5) will be placed between the reactors (see Figure 24-4); it will be drilled to a total depth of 15 ft, and will be sampled at the standard intervals. A total of 5 borings, yielding 24 samples, will be completed at this site as part of the Phase I program. Samples from all borings within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method, the breakdown products of lewisite using the organoarsenic method, and for organomercury compounds using the organomercury method. In addition, samples from these borings will be analyzed for the standard suite of Phase I analytes to detect any other contamination that may be present at the site. See Section 4.0 for a more detailed discussion of analytical methods.

The planned borings, depths, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
4	20	20	Phase I Analytes Organoarsenic Compounds Organomercury Compounds Thiodiglycol
1	15	4	Phase I Analytes Organoarsenic Compounds Organomercury Compounds Thiodiglycol


Possible Army Spill Site 2
Buried MI Settling B
(20)
(20)
(20)
(15)
TANK AREA
Historical location of Disposal Reactors (Building 513)
Reminants of 561A
-561
510
511
511A
512A
512
515
515A
51



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Aberdeen Proving Ground, Maryland

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FIGURE 24-4

Boring Location Map
Army Spill Site 2, Section I
Rocky Mountain Arsenal, Task 24

Prepared by Ebasco Services Incorporated

See Figure 24-2 for Vicinity Map.

Spill Site No. 3:

This spill area includes the lewisite reactor room of Building 514 (see Figure 24-2) where arsenic trichloride, mercury, and mercuric chloride spills reportedly occurred and were washed into floor drains which led to the Building 513 decontamination reactors (Shell, 1985; Kuznear & Trautmann, 1980; Donnelly, 1985a).

Evidence of residual contamination within these buildings will be researched as a part of the structures surveys for the South Plants area (Task 24). No borings are proposed.

Spill Site No. 4:

Mercury was reportedly spilled behind Building 512 (Figure 24-2) (Shell, 1985 and PMCDIR, 1977). Mercuric chloride was used in nearby Building 514 (RMA, 1945 (D)). The mercury catalyst utilized for the production of mercuric chloride was a solid (either powder or chunks), shipped to RMA in 50 to 100 lb drums and stored in a warehouse (Donnelly, 1985b). Elemental mercury would form from the mercuric chloride reacting with iron piping; this effluent was directed to the decontamination reactors (Spill Site No. 2) and then to the M-1 settling basins (Spill Site No. 2), where the heavy metal would theoretically settle out (Rosenblatt & Small, 1975). Further literature research has shown that the probability that mercury was spilled behind Building 512 is low due to the following:

1. V. Paiz, Sr., the former RMA employee referenced in the 1977 PMCDIR report was contacted in a follow-up telephone interview in November 1986 (Paiz, 1986). In this follow-up interview, Paiz claimed that he had heard about "a large mercury spill" that occurred prior to his arrival in 1945, but knew no other particulars. (It is believed that Paiz was referring to the mercury catalyst spill described in this report under Spill Site No. 39.)

2. Prior to 1945 (the year that Paiz began work at RMA), Building 512 was utilized as a lewisite filling plant. The building housed storage tanks for finished lewisite only (U.S. Army Corps of Engineers 1943a; RMA, 1945k).

3. Elemental mercury used on RMA was limited to:

   a) That received in small jars and used exclusively in instrumentation (Donnelly, 1985c);

   b) That used by Shell in orsate sampling (see Spill Site No. 24);

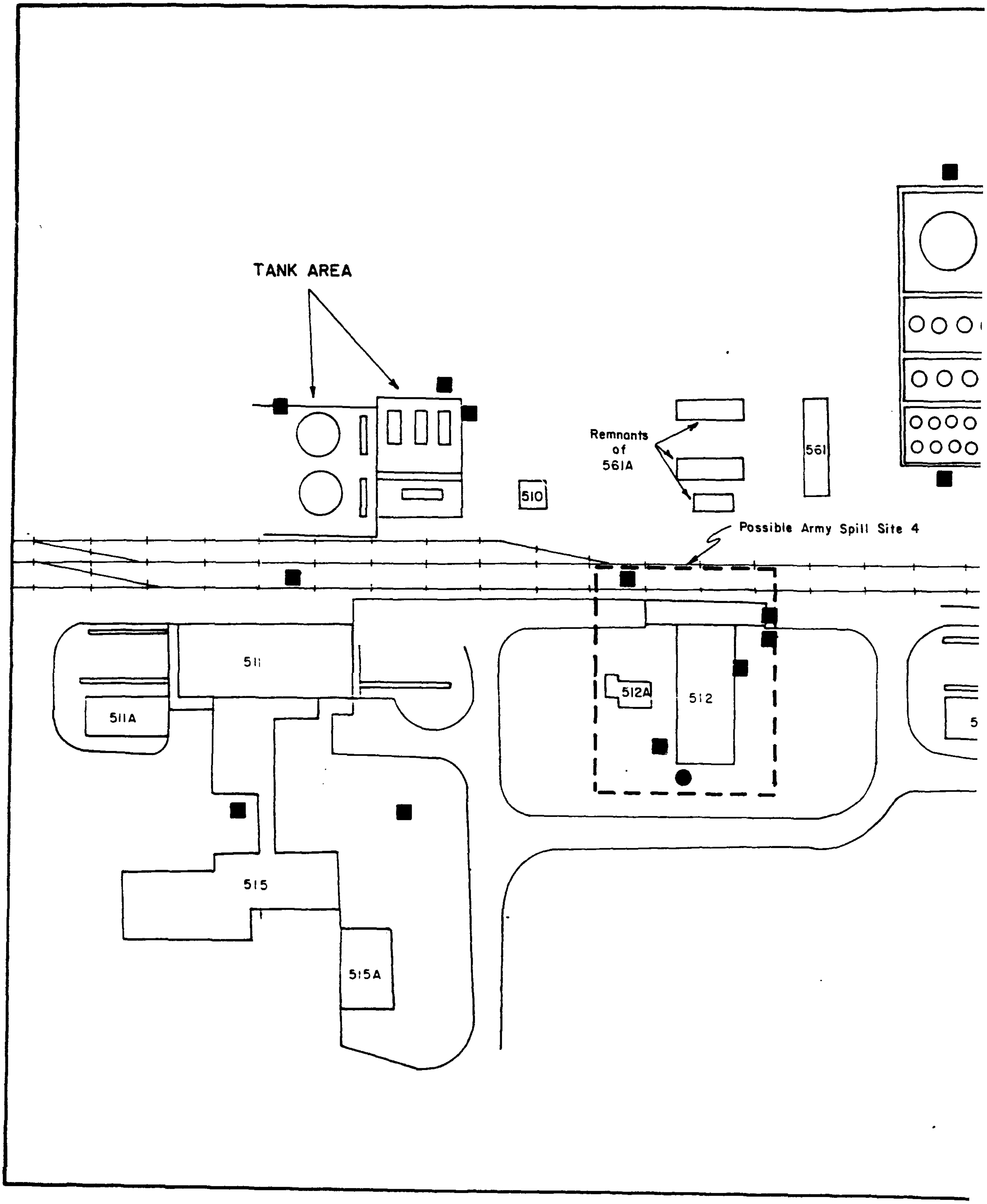
c) That used by the Army, CF&I, Hyman, and Shell, (1943-1957) in the rectifier room of the cell building (# 242) in the chlorine plant (U.S. Army, undated; U.S. Army, 1967; C.K. Hahn, undated; H.K. Ferguson, 1942); and

d) That used in manometers in steam metering stations in the South Plants area (no metering stations are located in the vicinity of Building 512) (Bisted, 1975).

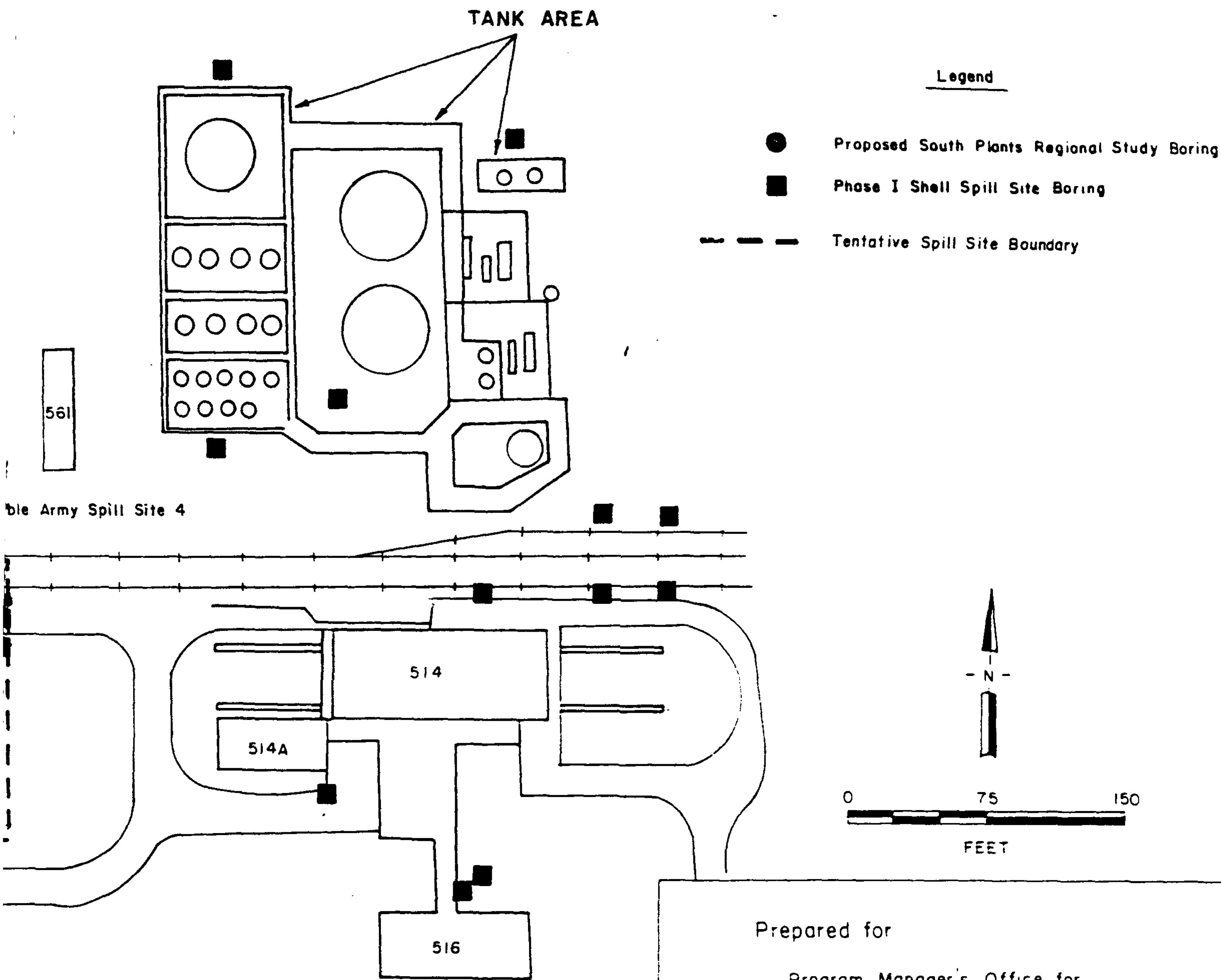
In fact, it has been estimated that the Army's use of elemental mercury was "nothing more than a half pint bottle...over a three month period" (Way, Vol. VI).

Although the literature indicates that mercury was not used in or near Building 512, mercury has been detected in 5 Task 2 borings in this vicinity (Figure 24-6) (Ebasco, 1987, January). An additional boring is proposed south of Building 512 under the Task 2 regional study (Ebasco, 1986e). Due to the coverage provided by these 6 borings, no additional borings are proposed around Building 512 under Task 24.

Whereas the probability of mercury being spilled around Building 512 is low, according to the literature, there may be a possibility of lewisite contamination inside Building 512. Here, lewisite was stored in six 2,350 gal. tanks in a room with no flooring. The ground absorbed spills and leaks, and was a continuous source of obnoxious fumes (COE, 1943b; RMA, 1945g). Additional field reconnaissance has shown that the floor is presently concrete and no openings on the building are large enough to allow drill rig access. No borings are thus proposed inside the building.



TANK AREA
Remnants of 561A
561
510
Possible Army Spill Site 4
511
511A
512A
512
515
515A



See Figure 24-2 for Vicinity Map

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FIGURE 24-5

Army Spill Site 4, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 5:

Between April and November 1943, large amounts of lewisite were reportedly lost through leakage from pipes and tanks in the lewisite production area (Figure 24-2) (Shell, 1985; Kuznear & Trautmann, 1980). Crude lewisite was processed in glass lined equipment in Building 514 and transferred to glass lined storage tanks in Building 514A through porcelain pipes. From Building 514A the lewisite was then sent to the distillation Building 516. The pipes and transfer equipment between Buildings 514A and 516 were composed of iron, which were entirely inadequate to withstand corrosive action (RMA, 1945h; Donnelly, 1985). This iron transfer equipment is believed to be inside the buildings (which are connected) because no pipes on the outside are continuous between the buildings (Figure 24-6). This will be further investigated under the Task 24 Structure Survey. Mercuric chloride was also reportedly utilized in this area.

Field reconnaissance in this area yielded no additional evidence of spills or leaks of lewisite or mercuric chloride around tanks or piping. (Piping between Buildings 514 and 512 will be investigated under Spill Site 40 of this report.)

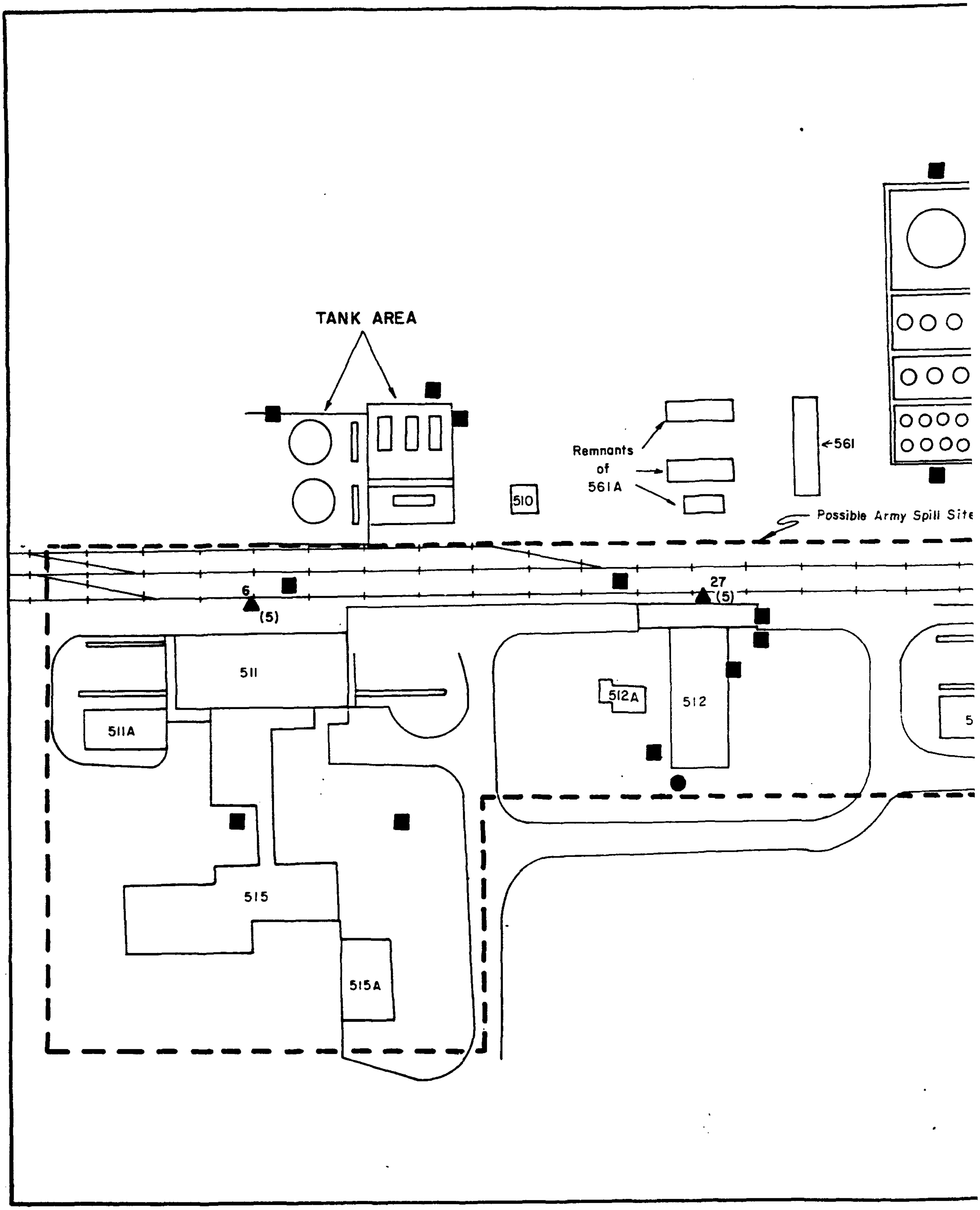
Recent discussions with George Donnelly (Donnelly, 1986) indicate that Buildings 512, 514, and 516 were not used for lewisite production but were used for mustard production. Due to this apparent discrepancy regarding the function of this complex of buildings, borings at the site will be analyzed for mustard breakdown products as well as for organomercury compounds and lewisite breakdown products.

Three additional borings will be drilled in this area under Task 24 (Spills) (Figure 24-6). These borings will be placed in depressions immediately north of Building 511 (Boring 6), 512 (Boring 27), and 514 (Boring 7). The borings will be located in areas believed to be within former loading areas, where the possibility of contamination due to spills is most likely. Each of the three borings will be drilled to a depth of 5 ft, and will be sampled at the 0 to 1 ft and 4 to 5 ft intervals. Samples from these borings will be analyzed for lewisite breakdown products utilizing the organoarsenic method, for mustard breakdown products using the thiodiglycol method, and for organomercury compounds using the organomercury method. See Section 4.0 for a more detailed discussion of analytical methods.

Evidence of contamination within the buildings will be researched as a part of the structures survey for the South Plants area (Task 24).

The planned borings, depths, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
3	5	6	Organoarsenic Compounds Organomercury Compounds Thiodiglycol


TANK AREA
510
Remnants
of
561A
561
Possible Army Spill Site
6
(5)
27
(5)
511
511A
512A
512
515
515A

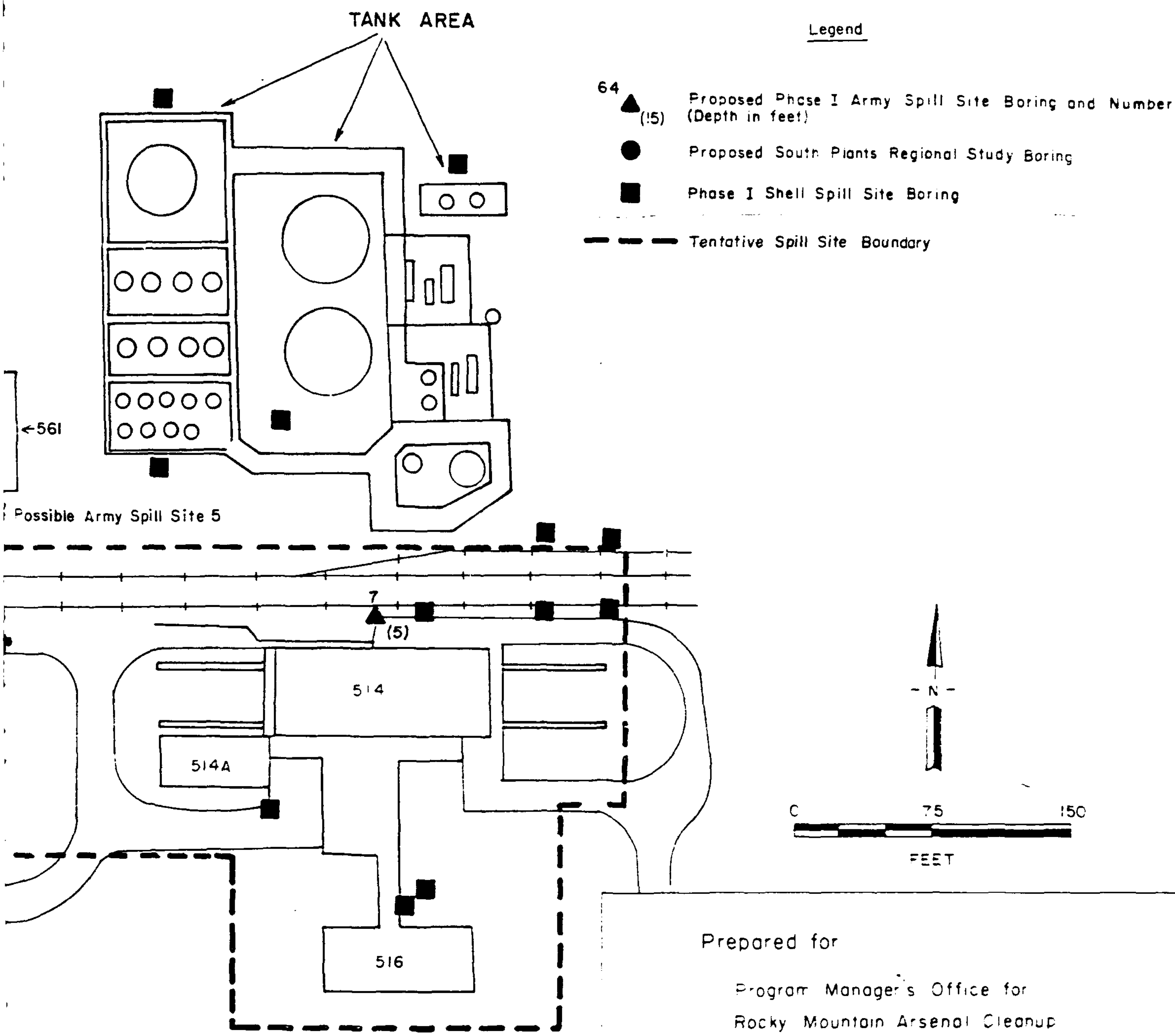


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FIGURE 24-6

Boring Location Map
Army Spill Site 5, Section I
Rocky Mountain Arsenal, Task 24

Prepared by Ebasco Services Incorporated

See Figure 24-2 for Vicinity Map

Spill Site No. 6:

An area of potential lewisite contamination was identified immediately west of Buildings 536 and 537 (Figure 24-2) (Shell, 1985). The exact nature and area of contamination has not been identified through research, but these areas are within the former mustard complex.

A total of 3 borings are proposed to investigate the area of potential lewisite contamination and they will be located in the drainage just west of Buildings 536 and 537 (Figure 24-7). Borings 14 and 15 will be drilled to a total depth of 5 ft, and sampled at the 0 to 1 and 4 to 5 ft intervals.

Boring 10 is located near the lowest point in the drainage and will be drilled to water table (anticipated at 20 ft) and sampled at the 0 to 1, 4 to 5, 9 to 10, 14 to 15, and 19 to 20 ft intervals.

Activities involving mustard distillation in this area are also identified in the literature; this information will be developed as part of the Task 24 Structures Survey. Because mustard handling occurred in this area, the samples from the 3 borings drilled on this site will be analyzed for the breakdown products of mustard using the thiodiglycol method, in addition to the breakdown products of lewisite using the organoarsenic method. Samples from Boring 10 will also be analyzed for the standard suite of Phase I analytes, due to its location at the low point of the drainage. This will help determine whether previously undetected contamination may be present. See Section 4.0 for a more detailed discussion of the analytical methods.

Further research has indicated the possibility of two additional areas possibly involving both mustard and lewisite:

1. The ton container storage yard north of Buildings 537 and 538 (Whitman, 1943; RMA, 1945e) (Shell's DET facility was constructed over a portion of this site); and

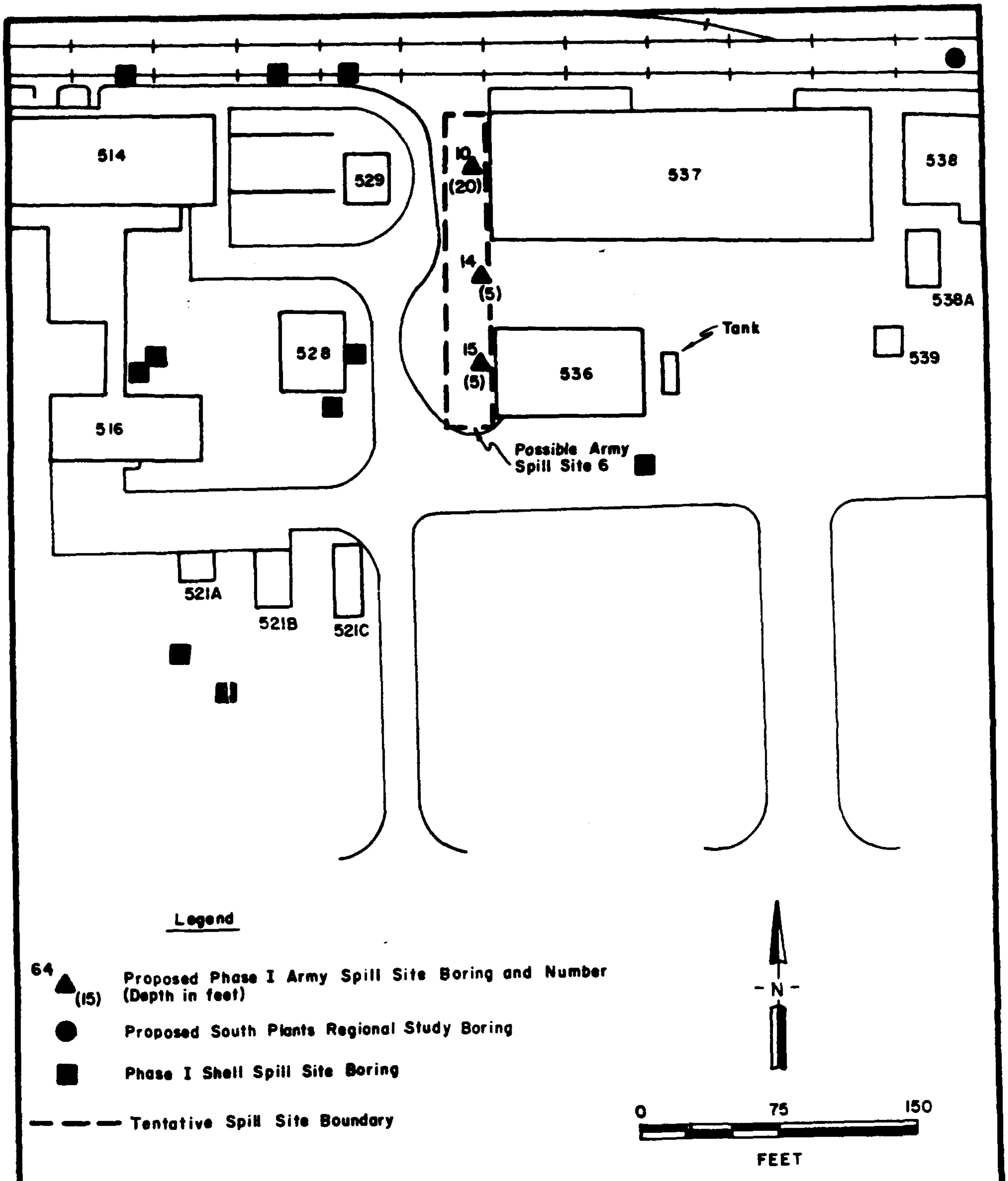
2. The ton container storage yard east of Building 538 (RMA, 1945). This area was also used during Project Eagle, Phase I, between August 1972 and November 1973. Ton containers containing mustard were drained in Building 537 and then stored in this yard prior to decontamination in furnaces in Building 538. After decontamination in the furnaces, the ton containers were again temporarily stored in this yard (Office of the DA Project Manager, 1975; Woodward, 1970). Twenty-three ton containers, all apparently empty and decontaminated, continued to be stored in this area in April, 1982 (Jacobs, 1982). During recent field reconnaissance in 1986, 22 ton containers were noted in this area; they appeared empty.

Field reconnaissance of the ton container storage area north of Buildings 537 and 538 (Area 1 above) has indicated that this area has been disturbed by excavation and construction. The majority of the area is covered by tank platforms, buildings, and pavement of asphalt, concrete, or gravel. Lack of detailed storage locations and spill history, combined with the construction disturbance noted above, has led to the decision that borings in this area would likely not be useful.

The ton storage area east of Building 538 (Area 2 above) has been drilled under Task 2 Site 1-3. Two borings were installed and were screened for Army agents by the RMA laboratory; results were negative. No additional borings are proposed for this area under Task 24.

The planned borings, depths, number of samples, and analytes for the drainage west of Building 537 are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
2	5	4	Organoarsenic Compounds Thiodiglycol
1	20	5	Phase I Analytes Organoarsenic Compounds Thiodiglycol



See Figure 24-2 for Vicinity Map

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FIGURE 24-7
Boring Location Map
Army Spill Site 6, Section I
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

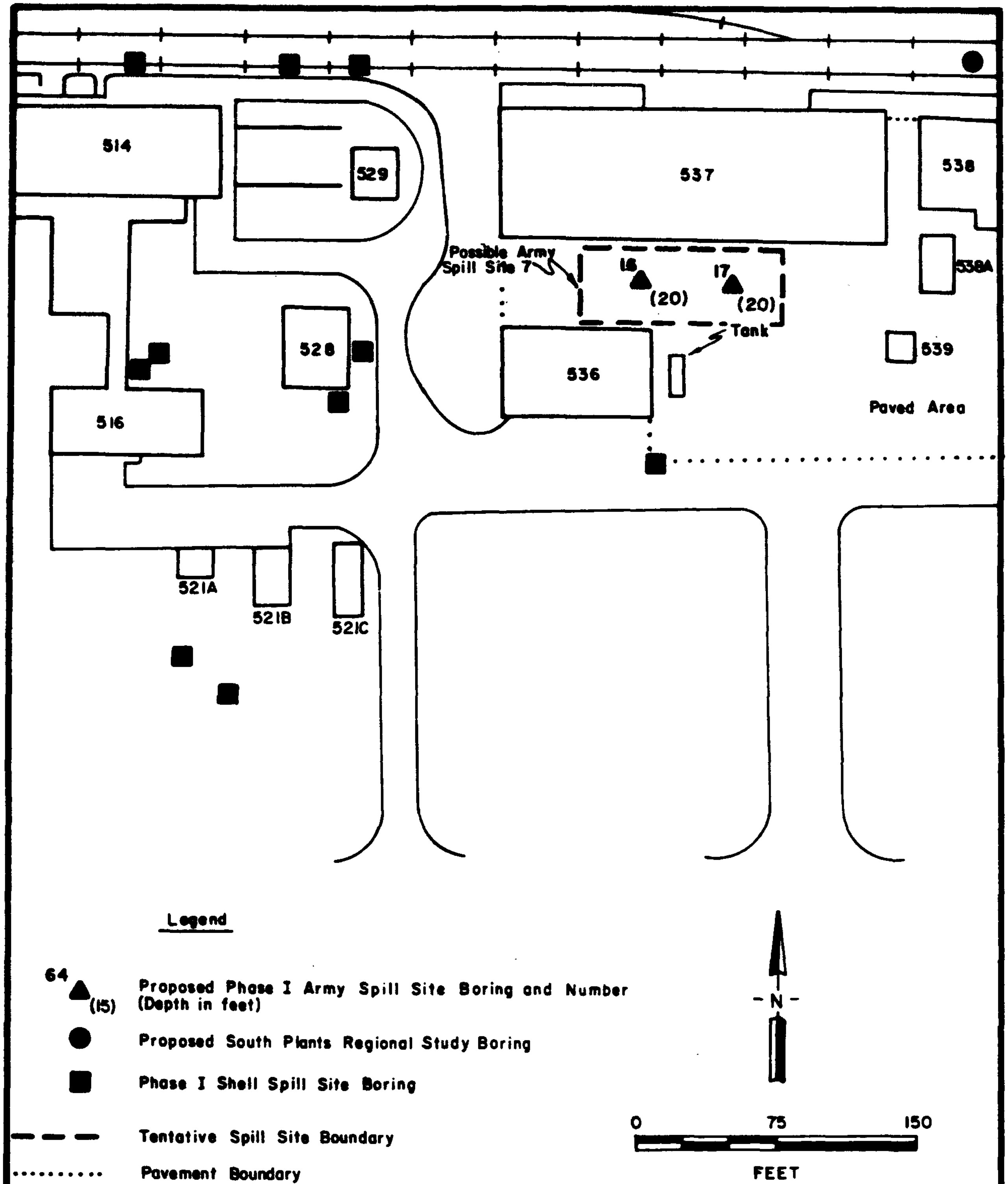
Spill Site No. 7:

In 1955, mustard was observed leaking from one-ton containers stored on an unpaved area northeast of Building 536 and south of Building 537 (see Figure 24-2). There is no information on the exact location or on the quantities spilled. (Shell, 1985; PMCDIR, 1977).

Two borings (16 and 17) are proposed to investigate the spill area (Figure 24-8). The borings will be located in the paved area south of Building 537; this pavement was laid over the old unpaved storage area where the one ton mustard containers were observed previously to be leaking. The borings will be drilled to the water table (anticipated to be at 20 ft below the ground surface). For these borings, samples will be taken from the standard intervals to 20 feet, and (if necessary) subsequently at 10 ft intervals. Samples from the borings within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method, and also for the Phase I analytes inorganic mercury and inorganic arsenic (see Section 4.0).

The planned borings, depths, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
2	20	10	Inorganic Arsenic Inorganic Mercury Thiodiglycol



See Figure 24-2 for Vicinity Map

Prepared for:	FIGURE 24-8
Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	**Boring Location Map** **Army Spill Site 7, Section I** Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated
Drafted: 11/26/86	

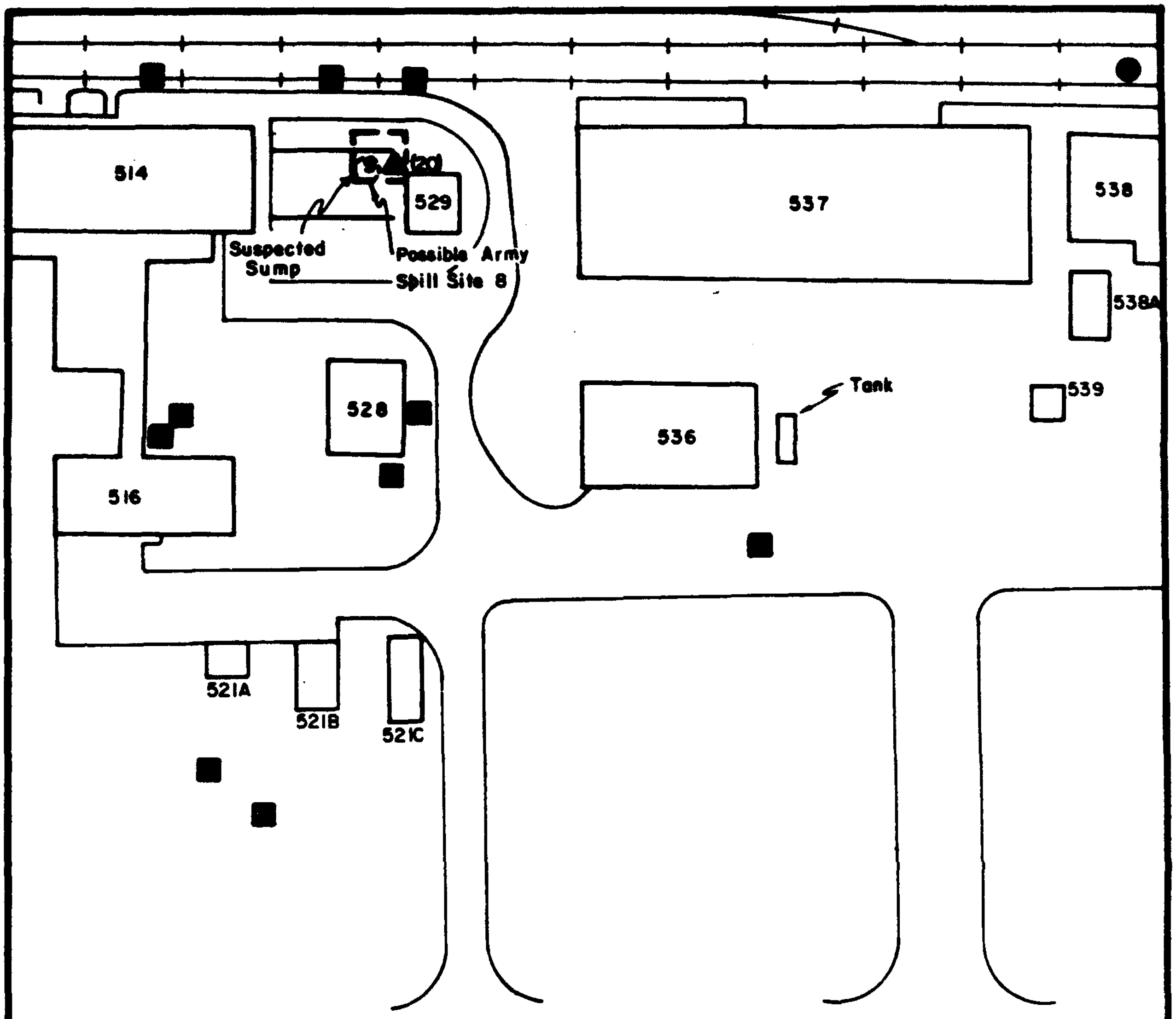
Spill Site No. 8:

In 1980, Shell employees reportedly encountered what they thought to be mustard as they were installing a sump tank as part of an overhead chemical sewer between Building 514 and Building 529 (see Figure 24-2) (Jones, 1984).

One boring (9) is proposed to investigate this spill area (see Figure 24-9). This boring will be located between Buildings 514 and 529 next to the suspected sump. The boring will be drilled to the water table (anticipated to be at 20 ft below the ground surface). Samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. Samples from the borings within this spill area will be analyzed for the standard suite of Phase I analytes, as well as for breakdown products of mustard by the thiodiglycol method (see Section 4.0).

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Thiodiglycol Phase I Analytes



Legend

- 64 ▲ (15) Proposed Phase I Army Spill Site Boring and Number (Depth in feet)
- ● Proposed South Plants Regional Study Boring
- ■ Phase I Shell Spill Site Boring
- — — — Tentative Spill Site Boundary

0 75 150
FEET

See Figure 24-2 for Vicinity Map

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FIGURE 24-9
Boring Location Map
Army Spill Site 8, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

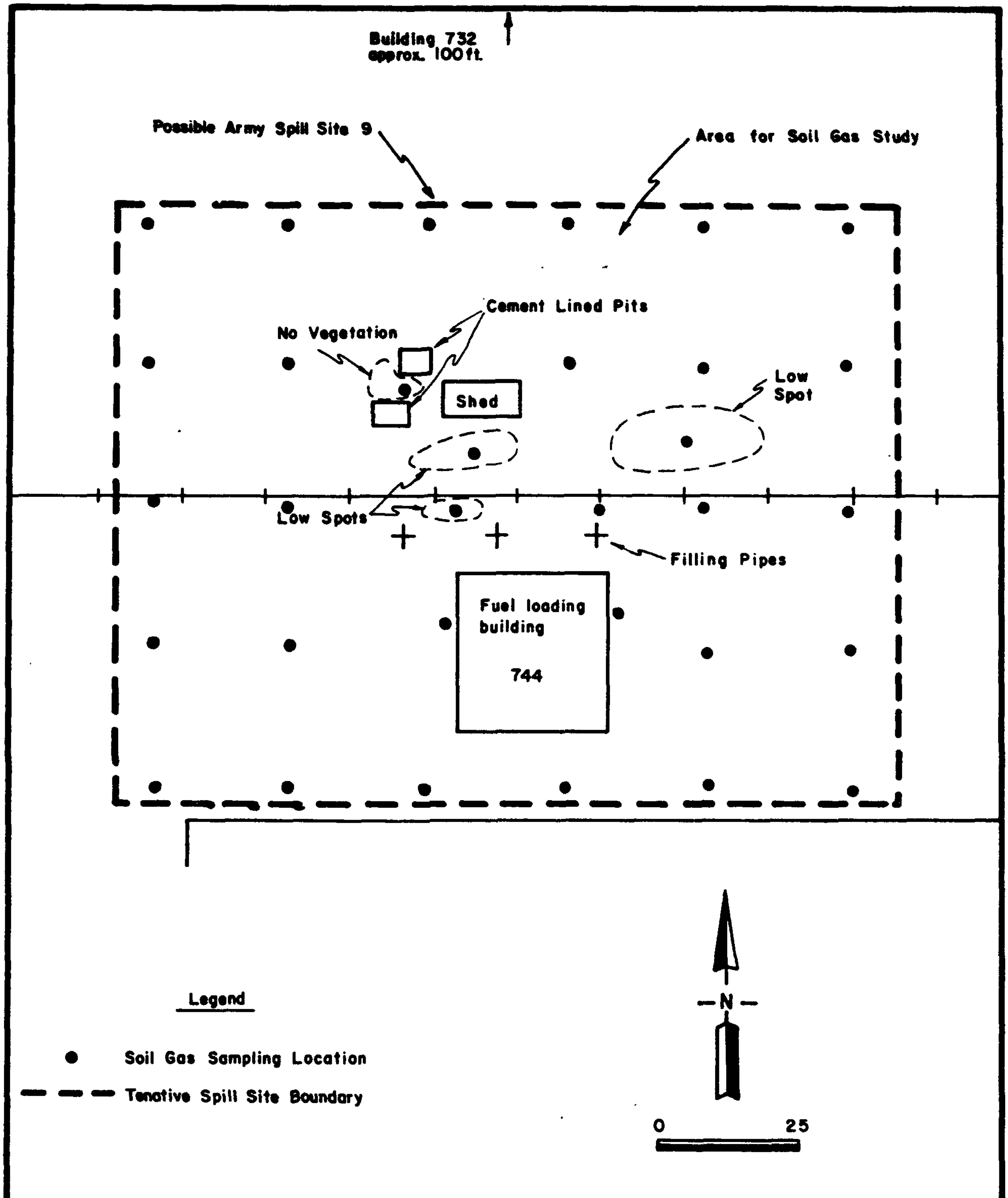
Spill Site No. 9:

This spill area is located approximately 100 ft south of Building 732, at a fuel loading area near Building 744 (see Figure 24-2). The spills involved diesel fuel lost from hoses while tank cars were being loaded. In 1975, a trailer tanker was overfilled, resulting in a spill of diesel fuel, which was washed down with about 50 gal. of water. The literature mentions that a truck was also present in the spill area at this time, and that it was also washed down with water. The diesel fuel and water reportedly entered the sanitary sewer system (Pimple, 1975; Shell, 1985).

Preliminary soil gas screening is proposed for this area (see Figure 24-10). The exact spill location is not certain, and as the documented spill area is likely quite small, the soil gas screening will aid in locating boreholes so that the spill area is not missed by drilling. In addition, data from the soil gas screening may aid in determining the lateral extent of the spill area so that the volume of contaminated soil at the site can be estimated. Previously undocumented spill areas at the site may also be located using the soil gas screening technique.

Based on conversations with the soil gas screening subcontractor (Target Environmental Services, Inc.), a 25 ft grid spacing was selected. This grid will cover an area of 12,500 ft^2 centered on the filling area north of Building 732. Additional sampling points were added or moved in three low areas and one area of stressed vegetation between the cement burial pits (Figure 24-10). A total of 32 sampling points will be analyzed for the signatures of diesel fuels. Specific compounds included in this analysis are benzene, toluene, total xylene, alkanes, methyl ethyl ketone, ethylbenzene, and total volatiles. A gas chromatograph equipped with a flame ionization detector will be used for analysis.

Once the results of the soil gas sampling are obtained and analyzed, soil borings will be placed as necessary to characterize the nature and extent of soil contamination at the site.



See Figure 24-2 for Vicinity Map

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FIGURE 24-10
Soil Gas Screening Area
Army Spill Site 9, Section 1
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

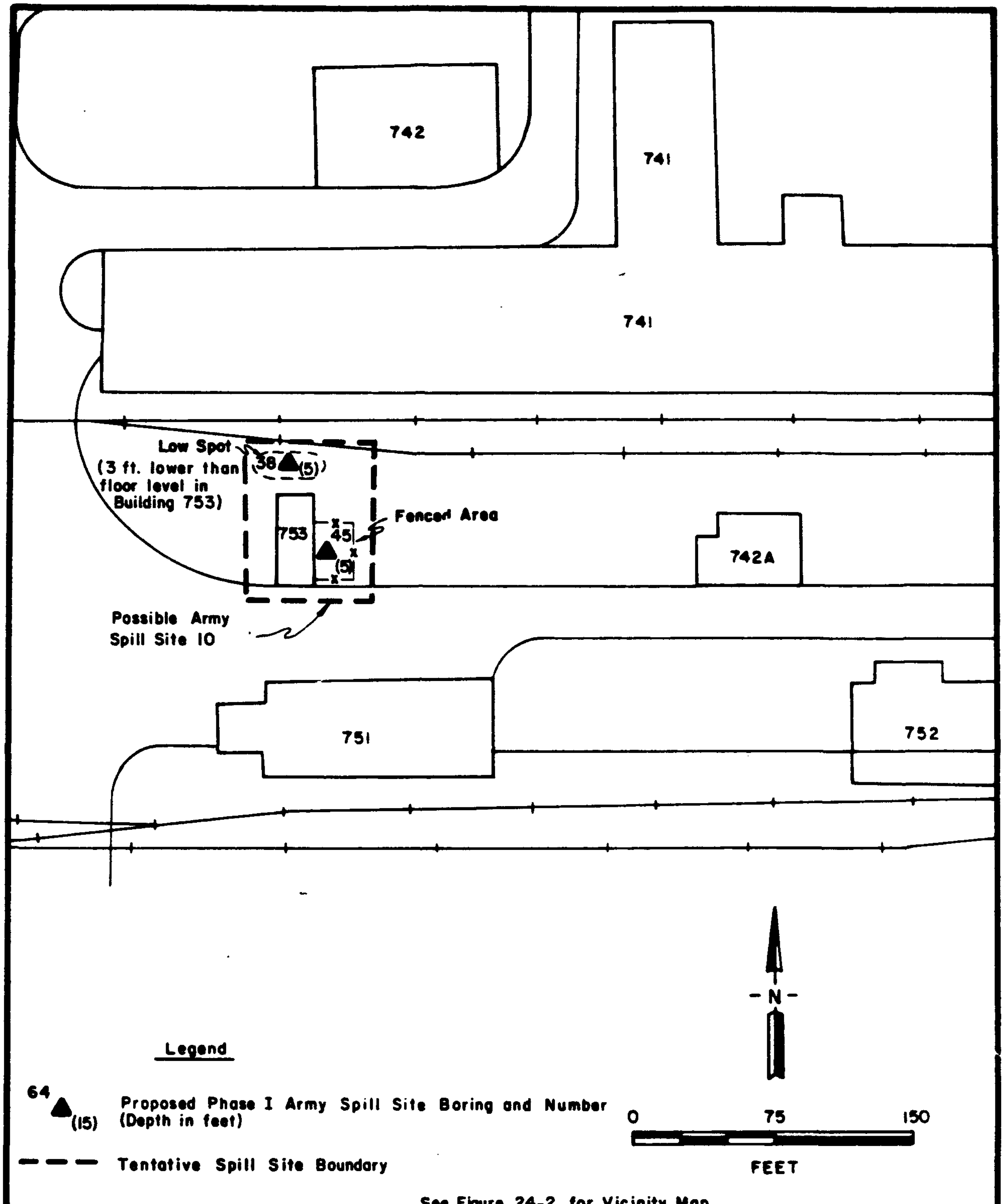
Spill Site No. 10:

In a letter from E.J. McGrath to T. Bick (Shell, 1985), Building 753 was reported to have been used for pesticide storage. The reference cited for the letter refers to "South Plants Contamination Survey and Remedial Action Assessment," Vol. I and II (Ebasco, 1985). That reference cites the "107 Report" (PMCDIR, 1977) and "Contamination Survey, Rocky Mountain Arsenal" (AMC, 1973), as authority for this building identification. However, neither reference identifies Building 753 as a pesticide storage building. Rather, Building 753 is identified in these reports as a steam fitter shop. Contamination within Building 753 will be assessed as a part of the Task 24 Structures Survey. Although literature does not indicate that the Army stored pesticides in Building 753, evidence does exist that indicates that the Army stored pesticides in Buildings 544 and 742 in the South Plants area. Information on these pesticides can be found in this report under Spill Sites 18 and 37, respectively. Additionally, pesticides were stored by the Army in Buildings 616 and 618 in the rail classification yard in Section 3. Also, pesticides were stored by the Army in Building 785 in the northwestern corner of Section 6. Finally, the Army stored pesticides in Shed 1, Plot 3 in the toxic yard of Section 6.

Two borings (38 and 45) are proposed to investigate this area (Figure 24-11). The purpose of these borings is to determine whether any substances used or stored in Building 753 have leaked or spilled, causing soil contamination external to the building. One boring will be drilled in the ditch north of Building 753, and the other boring will be located within the fenced area east of the building. Each will be drilled to a total depth of 5 ft. Samples will be taken from the 0 to 1 and 4 to 5 ft intervals. Samples from the borings within this spill area will be analyzed for the standard suite of Phase I analytes.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
2	5	4	Phase I Analytes



See Figure 24-2 for Vicinity Map

Prepared for:	FIGURE 24-11
Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	**Boring Location Map** Army Spill Site 10, Section I Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated
Drafted: 11/26/86	

Spill Site No. 11:

A spill of chlorobenzene reportedly occurred near the thionyl chloride plant (Building 471) (Figure 24-2) (Shell, 1985). Monochlorobenzene was used between April and November 1943 as a cooling medium during the heat-developing reaction stage of thionyl chloride production in the thionyl chloride reaction Building 471. The monochlorobenzene itself was stored in a 4,400 gal. capacity tank in Building 472, a single-story structure with cement flooring, containing an ammonia refrigeration system for the cooling of the warm monochlorobenzene returning from the reactors, pumps, and piping. The refrigeration piping between Buildings 471 and 472 was above ground (RMA, 1945; Ferguson, 1942a; Ferguson, 1942b; RMA, 1949; Ferguson, 1942c; COE, 1943 b; Donnelly, 1985d).

The only reference for this purported spill of chlorobenzene is Shell personnel interviews conducted in February 1985 (Shell, 1985). However, Shell was not yet conducting operations on RMA during 1943, the time of the reported spill (Kuznear & Trautmann, 1980). There are no documented chlorobenzene spills near Building 471 during the Army's production of thionyl chloride in 1943. All deponents queried about this alleged spill had no knowledge of such an incident. (It is suspected that the interviewed Shell personnel confused this alleged spill with reported spills of chlorobenzene by Colorado Fuel and Iron Corporation between 1947 and 1948 (Shell, 1985)).

Evidence of possible contamination within this building will be researched as a part of the structure surveys for the South Plants area (Task 24). If further research indicates more specifically where this spill may have occurred, borings will be placed as necessary to identify the nature and extent of the soil contamination that may have resulted from the spill.

Spill Site No. 12:

The acetylene manufacturing plant operated for a period of eight months from April to November 1943. Lime sludge from two acetylene generators in Building 522 (Figure 24-12) was discharged to pits outside of the generator rooms from where it was sent to one of three places:

1) The M-1 settling basins (Spill Site No. 2);
2) The Section 36 lime ponds via overhead lines (Site 36-4); or
3) The SO_2 disposal plant (Building 524).

Two borings (24 and 25) will be drilled to investigate the holding pits outside of Building 522 (Figure 24-12). Both borings will be drilled to the water table (anticipated to be at a depth of 20 ft below the ground surface); samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals.

The planned borings, depths, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
2	20	10	Phase I Analytes

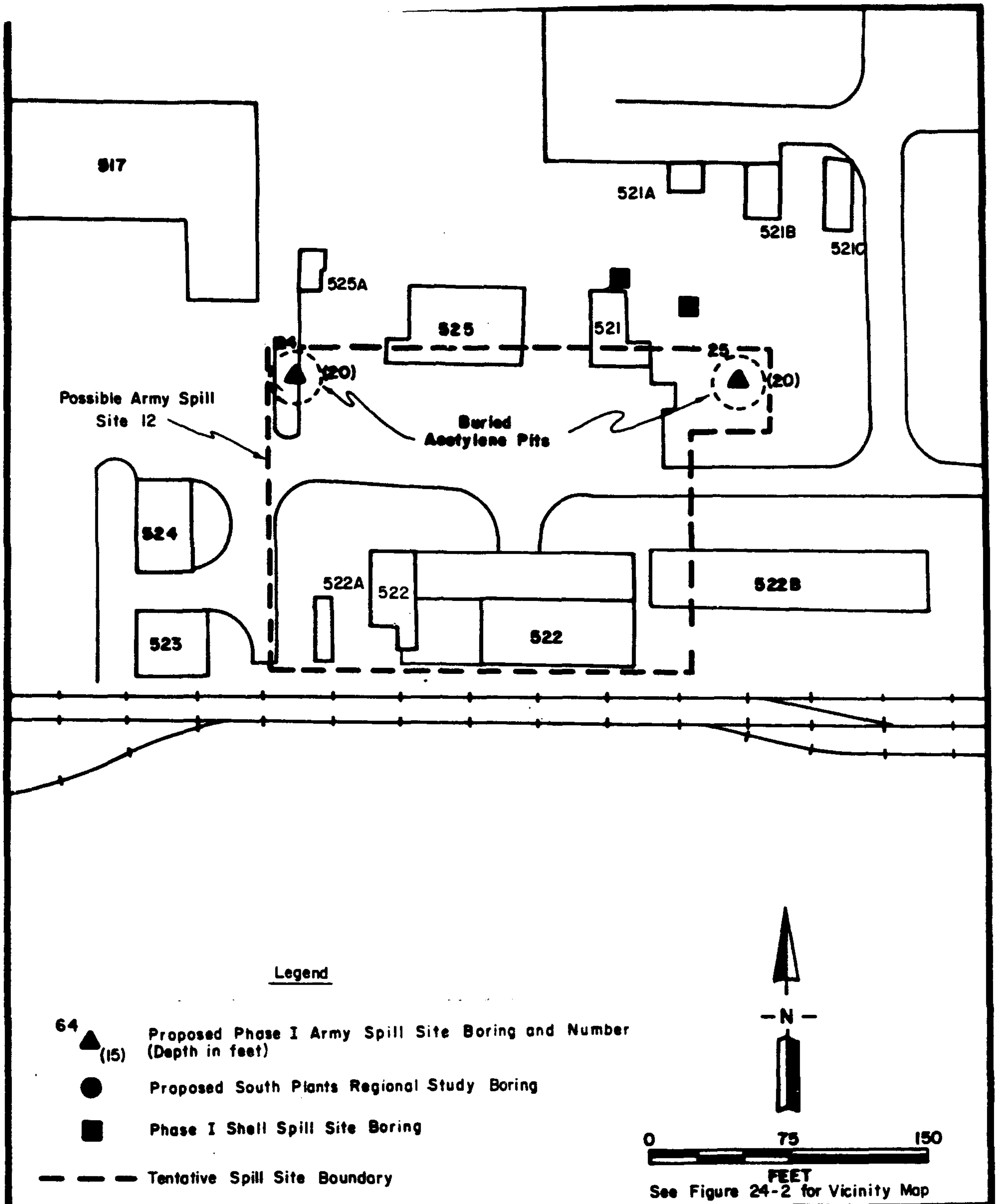


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FIGURE 24-12

Boring Location Map
Army Spill Site 12, Section I

Rocky Mountain Arsenal, Task 24

Prepared by: Ebasco Services Incorporated

Spill Site No. 13:

This spill occurred in the vicinity of arsenic storage silos 523C, 523D, 523E, 523F, 523G and associated conveyance and loading areas (see Figure 24-2). The arsenic trioxides utilized by the Army were fine, powdery substances. The spill or spills involved arsenic trioxide dust leaks from silos, conveyors, and hoses.

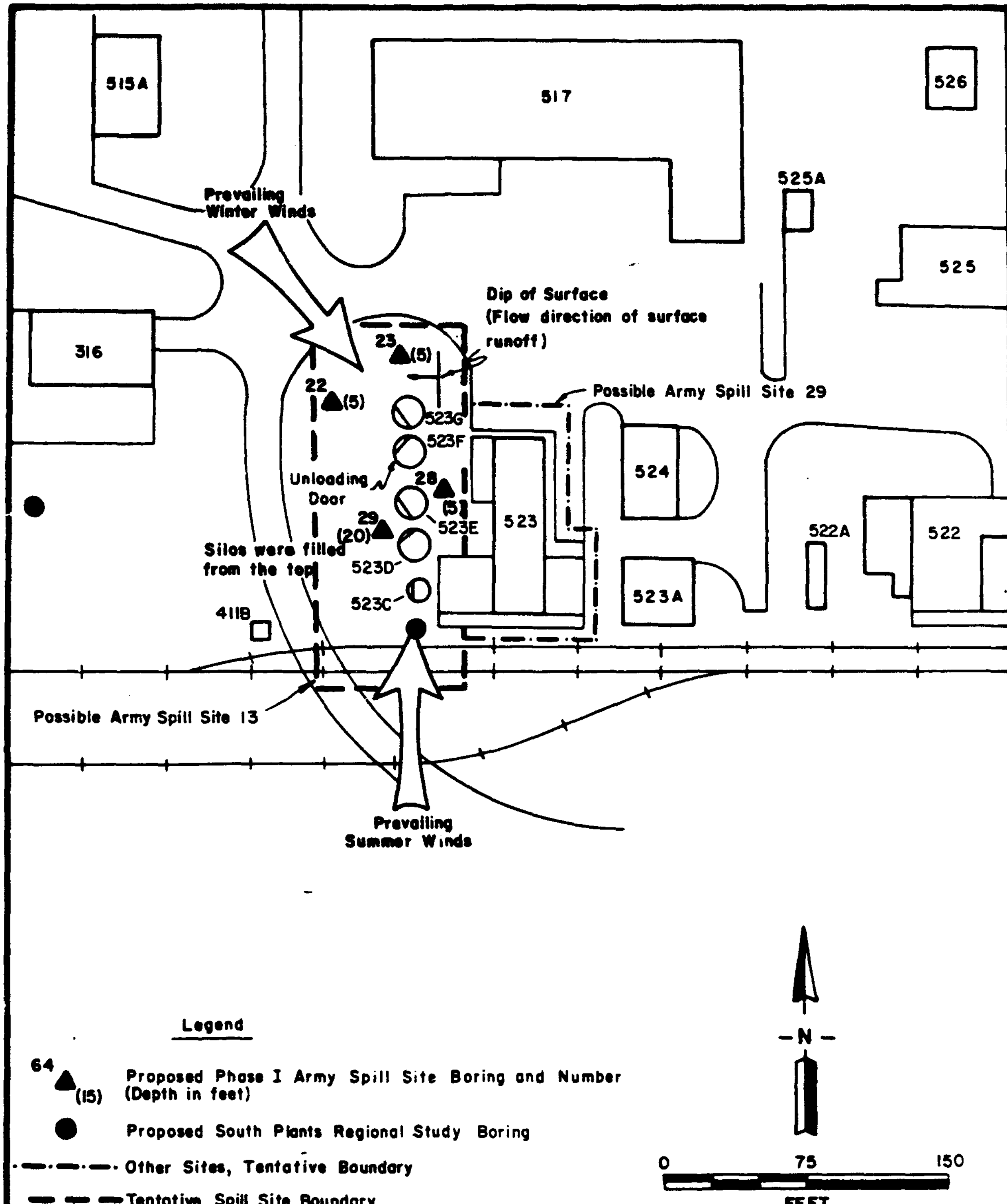
Building 523, directly to the east of the silos, housed reactors which had safety-seal tops. One of these seals apparently failed in April 1943, resulting in the release of a cloud of arsenic trichloride dust (Donnelly, 1986).

Four borings are proposed to investigate the spill area (see Figure 24-13). The borings will be placed near the arsenic trioxide storage silos. Since arsenic trioxide is a fine powder that is easily wind-transported, prevailing windflow patterns were taken into account in determining the boring locations. The borings have been placed in downwind locations, in areas thought to most likely be affected by windblown arsenic trioxide.

One boring (29) (Figure 24-13) will be drilled to the water table (anticipated to be at 20 ft below the ground surface), in the area of highest suspected contaminant concentrations. For this boring, samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. One boring (28) east of the silos will be drilled to a depth of 5 ft, to aid in delineating arsenic trioxide contamination occurring when dust blew off the tops of the silos during conveyor belt loading of the silos. Samples will be taken at the 0 to 1 and 4 to 5 ft intervals from this boring. Two borings (22 and 23) will also be drilled to 5 ft, north and east of the silos, to aid in delineating the extent of arsenic trioxide contamination in those areas. As the ground surface dips to the west in these areas, arsenic trioxide may have been transported to this area by surface water flow as well as by the prevailing winds. In addition, Boring 22 is in the low area for the site, which is likely a natural collection point for any other contaminants that may have been transported by surface runoff. These borings will be sampled at the 0 to 1 and 4 to 5 ft intervals. Samples from all borings within this spill area will be analyzed for lewisite breakdown products using the organoarsenic method. In addition, samples from Boring 22 will be analyzed for the standard suite of Phase I analytes to detect any other previously unidentified contaminants that may be present. See Section 4.0 for a more detailed discussion of analytical methods.

The planned borings, depths, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Organoarsenic Compounds
2	5	4	Organoarsenic Compounds
1	5	2	Phase I Analytes Organoarsenic Compounds



See Figure 24-2 for Vicinity Map

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Aberdeen Proving Ground, Maryland

Drafted: 11/26/86

FIGURE 24-13

Boring Location Map
Army Spill Site 13, Section I

Rocky Mountain Arsenal, Task 24

Prepared by Ebasco Services Incorporated

Spill Site No. 14:
During mustard production, "wild" (off specification) batches of mustard that did not meet desired purity standards were sometimes produced. To eliminate a "wild" batch, it was sent through overhead piping to disposal reactors (Building 416 and Building 426) (Figure 24-14) where it was neutralized with caustic. From the disposal reactor, the batch was piped to decontamination pits (Building 417 and Building 427) (Figure 24-14), where it was further treated with caustic before being sent to the chemical sewer leading to Basin A (Site 36-1)(RMA, 1945i; Kuznear & Trautmann, 1980).

This disposal process was conducted in two distinct areas: the yard west of Building 412 and the area between Buildings 422 and 471. Within the yard west of Building 412, one mustard decontamination pit has been definitely located. It is 7 ft 4 in. wide, 10 ft 10 in. long, and 6 ft 3 in. deep, and has a steel grid cover (PMCDIR, 1977). Foundations for the disposal reactor Building 416, caustic makeup Building 415, and the circulating and scrubbing Building 419 are also present in this westernmost yard. In the area between Buildings 422 and 471, subsequent construction has destroyed or covered everything except the disposal reactor Building 426.

In this east area, 3 Task 2 borings (Phase I) were placed around Building 424A. Analytes detected within or above indicator levels include aldrin, dibromochloropropane, dieldrin, endrin, isodrin, PPDDE, PPDDT, arsenic, mercury, copper, zinc, and cadmium. Two additional borings (34 and 35) are proposed under Task 24 (Spills) for this area between Buildings 422 and 471 (see Figure 24-14). If possible, one boring (34) will be placed in the decontamination pit that reportedly was located in this area. This boring will be drilled to the water table (anticipated to be at a depth of 20 ft below the ground surface). It may be necessary to penetrate concrete to place this boring. Techniques for drilling through concrete are discussed in the plan for Spill Site 15. The second boring (35) will be located next to the disposal reactor, east of former Building 424C (Whitman, 1942). This boring will be drilled to 5 ft above the water table (anticipated to be at 20 ft), for a total depth of 15 ft. Samples will be taken from the standard intervals in both borings to 20 ft, and (if necessary) subsequently at 10 ft intervals. Samples from the borings within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method. Additionally, samples from Boring 34 will be analyzed for the standard suite of Phase I analytes to determine if previously unidentified contaminants are present in this area. See Section 4.0 for a more detailed discussion of the analytical methods that will be utilized.

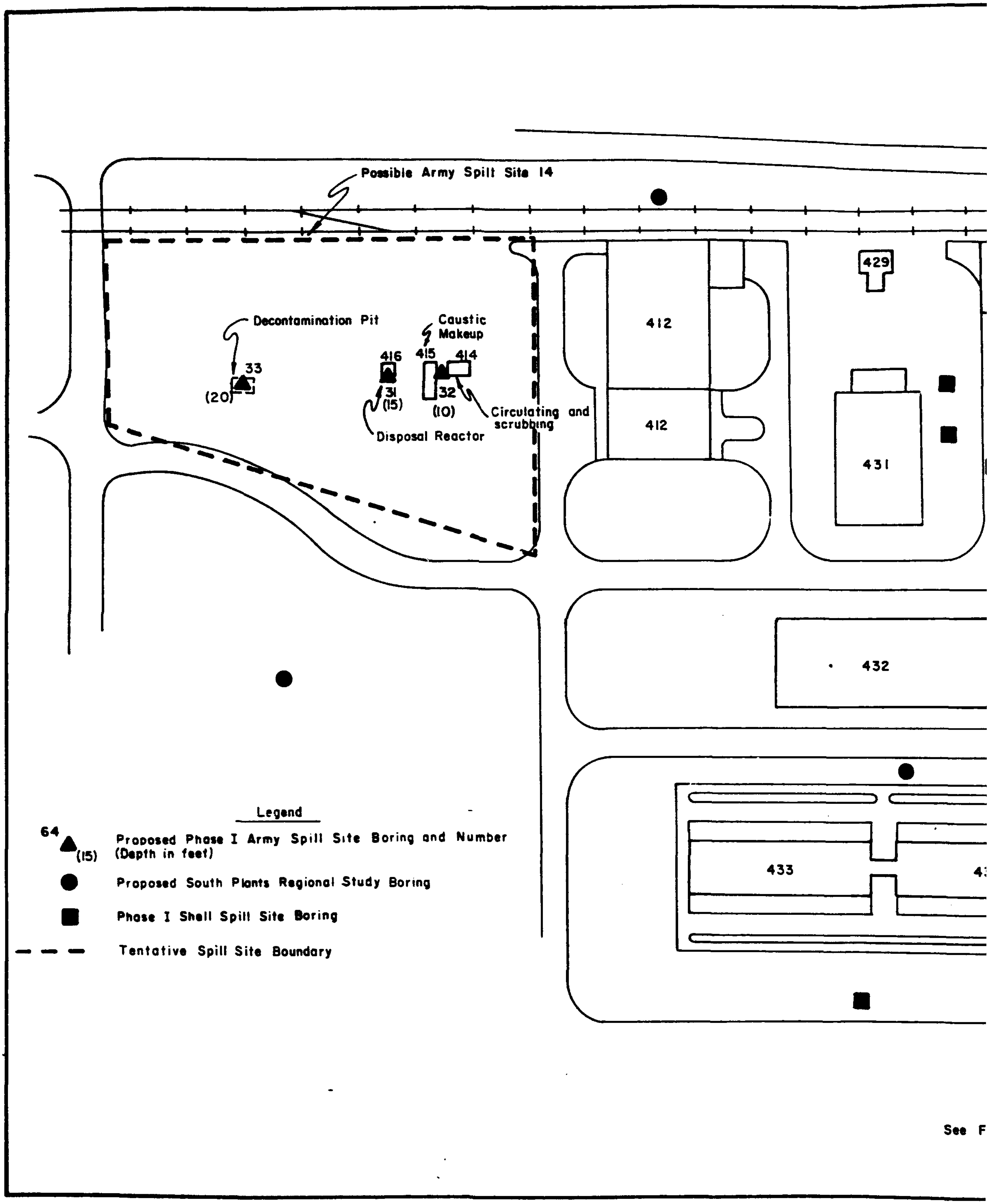
The planned borings, depth, number of samples, and analytes for the east area are summarized as follows:

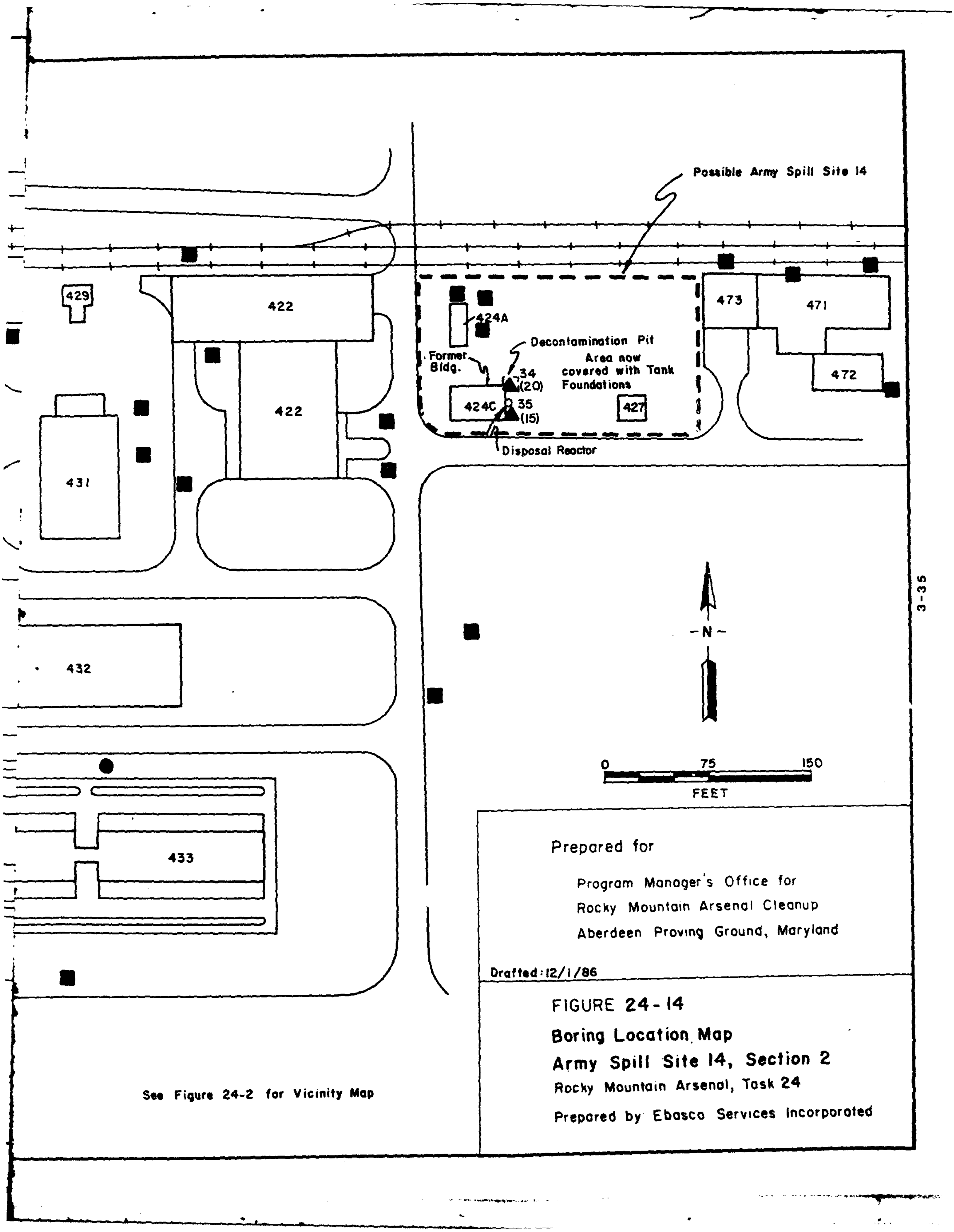
Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Phase I Analytes Thiodiglycol
1	15	4	Thiodiglycol

Three borings are proposed for the westernmost portion of this spill area (in the yard west of Building 412). One boring (33) will be located in the center of the decontamination pit and be drilled to the water table (anticipated to be at 20 ft below the ground surface). Samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. One boring will be located next to the disposal reactor (Whitman, 1942) located within the west yard (31); this boring will be drilled to a depth of 15 ft. Samples will be taken from the standard intervals to 15 ft. One boring (32) will be located between the former caustic makeup building (foundation of Building 415) and the former circulating and scrubbing building (foundation of Building 414) (Whitman, 1942); it will be drilled to a depth of 10 ft. Samples will be taken from the 0 to 1, 4 to 5, and 9 to 10 ft intervals. Samples from the borings within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method. Additionally, samples from Boring 33 will be analyzed for the standard suite of Phase I analytes to determine if previously unidentified contaminants are present in this area. See Section 4.0 for a more detailed discussion of the analytical methods that will be utilized.

The planned borings, depths, number of samples, and analytes for the west area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Phase I Analytes Thiodiglycol
1	15	4	Thiodiglycol
1	10	3	Thiodiglycol


Possible Army Spill Site 14
Decontamination Pit
Caustic Makeup
416
415
414
33
(20)
31
(15)
32
(10)
Circulating and scrubbing
Disposal Reactor
412
412
429
431
432
433
Legend
64
(15)
Proposed Phase I Army Spill Site Boring and Number (Depth in feet)
Proposed South Plants Regional Study Boring
Phase I Shell Spill Site Boring
Tentative Spill Site Boundary
See F



See Figure 24-2 for Vicinity Map

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FIGURE 24-14
Boring Location Map
Army Spill Site 14, Section 2
Rocky Mountain Arsenal, Task 24

Prepared by Ebasco Services Incorporated

Spill Site No. 15:

From July 1945 to 1946, the mustard distillation plant was operational. Crude mustard was washed with water and allowed to separate. The contaminated water, containing soluble iron and sulfur compounds, mustard, and "other toxic and undesirable impurities" (Kuznear & Trautmann, 1980) was discharged to a decontamination pit that reportedly was located near the southeast corner of Building 514 (War Department, 1948) (see Figure 24-2). The pit was lead lined concrete, and the wastes were reportedly neutralized with caustic (Shell, 1985, Ebasco, 1986; RMA, 1945j).

One boring (13) is proposed in this decontamination pit (see Figure 24-15). If the pit is filled with unknown material or wind blown deposits, the normal augering technique will be used to advance through this material until the floor lining is encountered. The materials in the pit will be sampled at the 0 to 1 ft and 4 to 5 ft intervals. A sample will be taken from the 1 ft section immediately above the floor of the pit. The fill material will be analyzed for Phase I analytes and Army breakdown products.

After the floor of the pit is encountered, a special cement cutting auger will be used to penetrate the cement lining. After the lining is penetrated, normal augering techniques and sampling procedures will be used, taking the first sample from immediately beneath the liner. If there is no material in the pit able to be sampled, the first 1 ft sample will be taken immediately beneath the liner. Standing liquid in the pit will be removed before penetrating the lining to prevent cross contamination.

This boring will be drilled to the water table (anticipated to be at a depth of 20 ft below the ground surface). Samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals.

Samples from the boring within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method. Additionally, samples from the boring will be analyzed for the standard suite of Phase I analytes to determine if previously unidentified contaminants are present in this area. See Section 4.0 for a more detailed discussion of the analytical methods that will be utilized.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Phase I Analytes Thiodiglycol

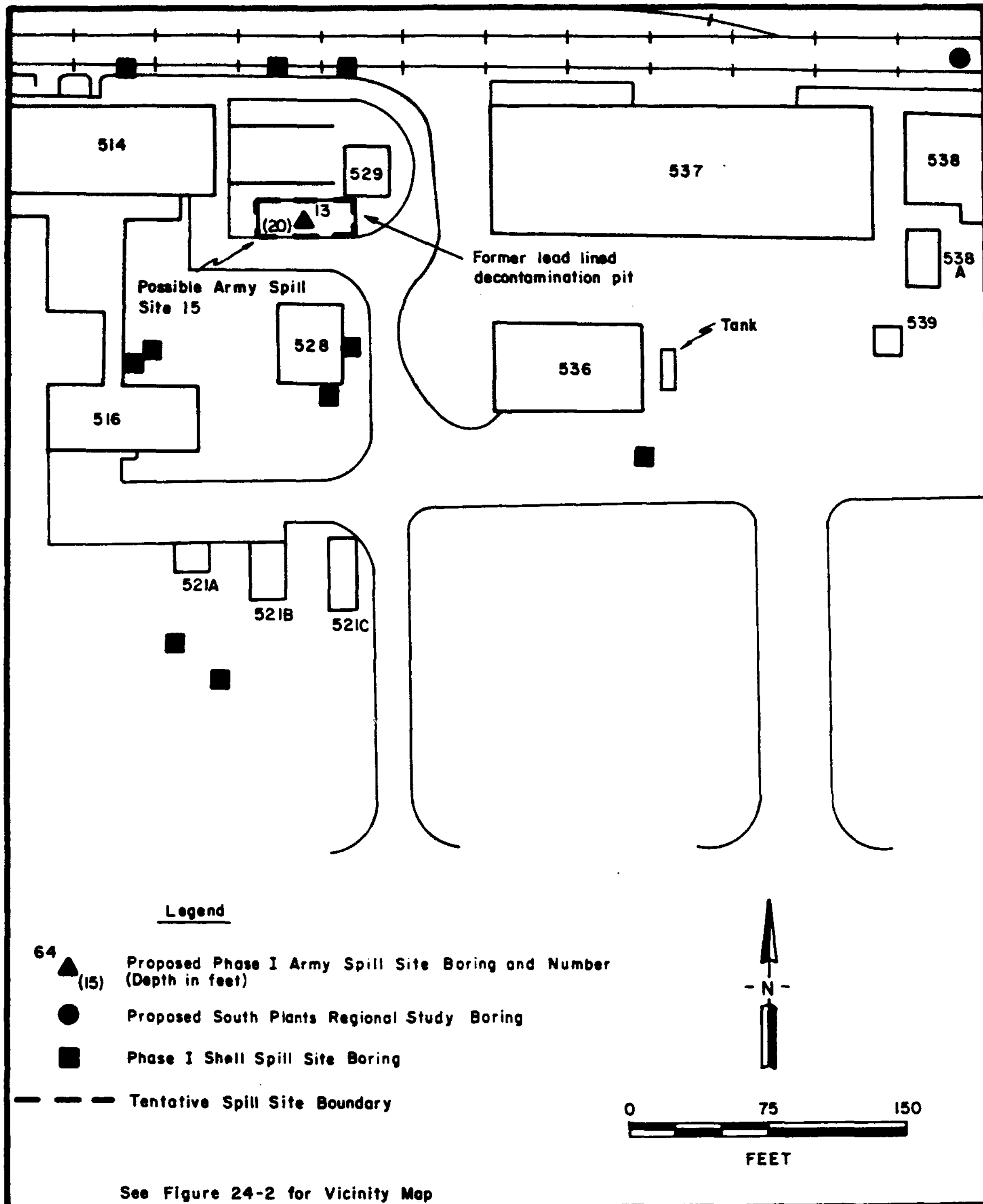

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FIGURE 24-15
Boring Location Map
Army Spill Site 15, Section I
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

Spill Site No. 16:

Waste water, decon water, and clothing treatment impregnation solutions containing sodium hypochlorite (Kuznear & Trautmann), acetylene tetrachloride (History of RMA), tetrachloroethylene (Esquibel, undated; Kemper, 1966; Hulbert, 1967; Industrial Hygiene Special Study, 1972), 3-octachlorocarbonalid (Kuznear & Trautmann, 1980), ammonium chloride (Martin, 1971), polyvinyl alchohol (Esquibel, undated), chlorinated parrifin (Ibid), disponal (Ibid.), daxad (Ibid), and dye (Ibid.) were released from the laundry facility. Until 1957, aqueous waste from the laundry was discharged to an open ditch that led to the chemical sewer which emptied to Basin A (Site 36-1) (Donnelly, 1985e; Kuznear & Trautmann, 1980). Between 1957 and 1979 the wastes were discharged through the chemical sewer to Basin F. Beginning in March 1979 the waste was sent to the South Plants waste collection system which included a 170,000 gal. storage tank which was periodically emptied and the contents hauled off-post. In November 1981 when hazardous substances were no longer present in the waste streams, laundry discharge was connected to the sanitary sewer system (Value Engineering Project Summary Book, 1981; Barbieri, 1981).

One boring (20) is planned to investigate the unlined ditch that led to the chemical sewer. The boring will be located east of Building 314 (see Figure 24-16), in the ditch which has now been filled (U.S. Engineers Office, 1946). This boring will be drilled to the water table (anticipated to be at a depth of 15 ft below the ground surface), and, at a minimum, to the bottom of the former ditch, even though the water table may be encountered at a shallower depth. Samples will be taken from the standard intervals to 15 ft, and (if necessary) subsequently at 5 ft intervals. Samples from the boring within this spill area will be analyzed for the breakdown products of lewisite using the organoarsenic compounds method and for the breakdown products of mustard using the thiodiglycol method. Additionally, samples from this boring will be analyzed for the standard suite of Phase I analytes to determine if substances used in clothing treatment were discharged to the ditch. See Section 4.0 for a more detailed discussion of the analytical methods that will be utilized.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	15	4	Phase I Analytes Organoarsenic Compounds Thiodiglycol

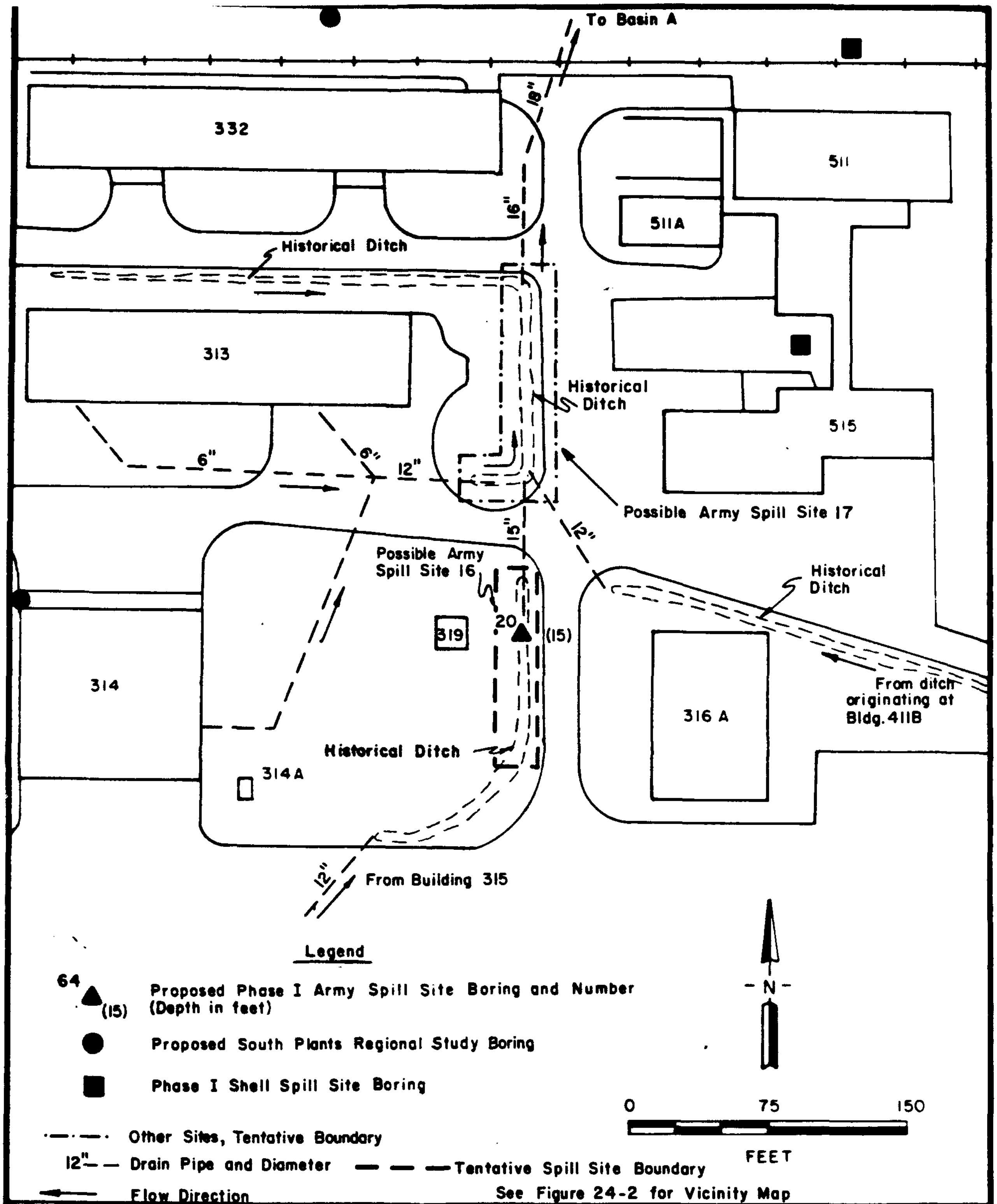

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FIGURE 24-16
Boring Location Map
Army Spill Site 16, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 17:

Building 313 was used as a primary analytical and testing laboratory by the Army (Figure 24-2). Wastewater from the laboratory sinks drained into an open ditch east of Building 313. The drainage ditch drained to Basin A (Shell, 1985; Kuznear & Trautmann, 1980). Information regarding the potential contaminants in the wastewater has not been located.

Two borings (11 and 12) are proposed for this spill area (Figure 24-17). The borings will be located to sample the drainage that historically led from the eastern portion of Building 313 to Basin A (U.S. Engineers Office, 1946).

The proposed boring nearest the south end of the ditch will be drilled to the water table (anticipated to be at a depth of 15 ft below the ground surface in this area), and, at a minimum, to 1 ft below the bottom of the ditch (even if the water table is encountered above the bottom of the ditch). Samples will be taken from the standard intervals to 15 ft, and (if necessary) subsequently at 5 ft intervals. The second proposed boring will be located in the northern portion of the ditch (see Figure 24-17). This boring will also be drilled to the water table (anticipated to be at 15 ft below the ground surface in this area). Samples will be taken from the 0 to 1 ft, 4 to 5 ft, 9 to 10 ft, and 14 to 15 ft intervals, and (if necessary) subsequently at 5 ft intervals. This boring will be drilled, at a minimum, to the total depth of the ditch, even though the water table may be encountered at a shallower depth. Samples from the boring within this spill area will be analyzed for the breakdown products of lewisite using the organoarsenic method, for the breakdown products of mustard using the thiodiglycol method, and for organomercury using the organomercury method. Additionally, since the nature of potential contaminants that may have been discharged with the wastewater is not well defined, samples from the boring will be analyzed for the standard suite of Phase I analytes. See Section 4.0 for a more detailed discussion of the analytical methods that will be utilized.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	15	4	Phase I Analytes Organoarsenic Compounds Thiodiglycol Organomercury Compounds
1	15	4	Phase I Analytes Organoarsenic Compounds Thiodiglycol Organomercury Compounds

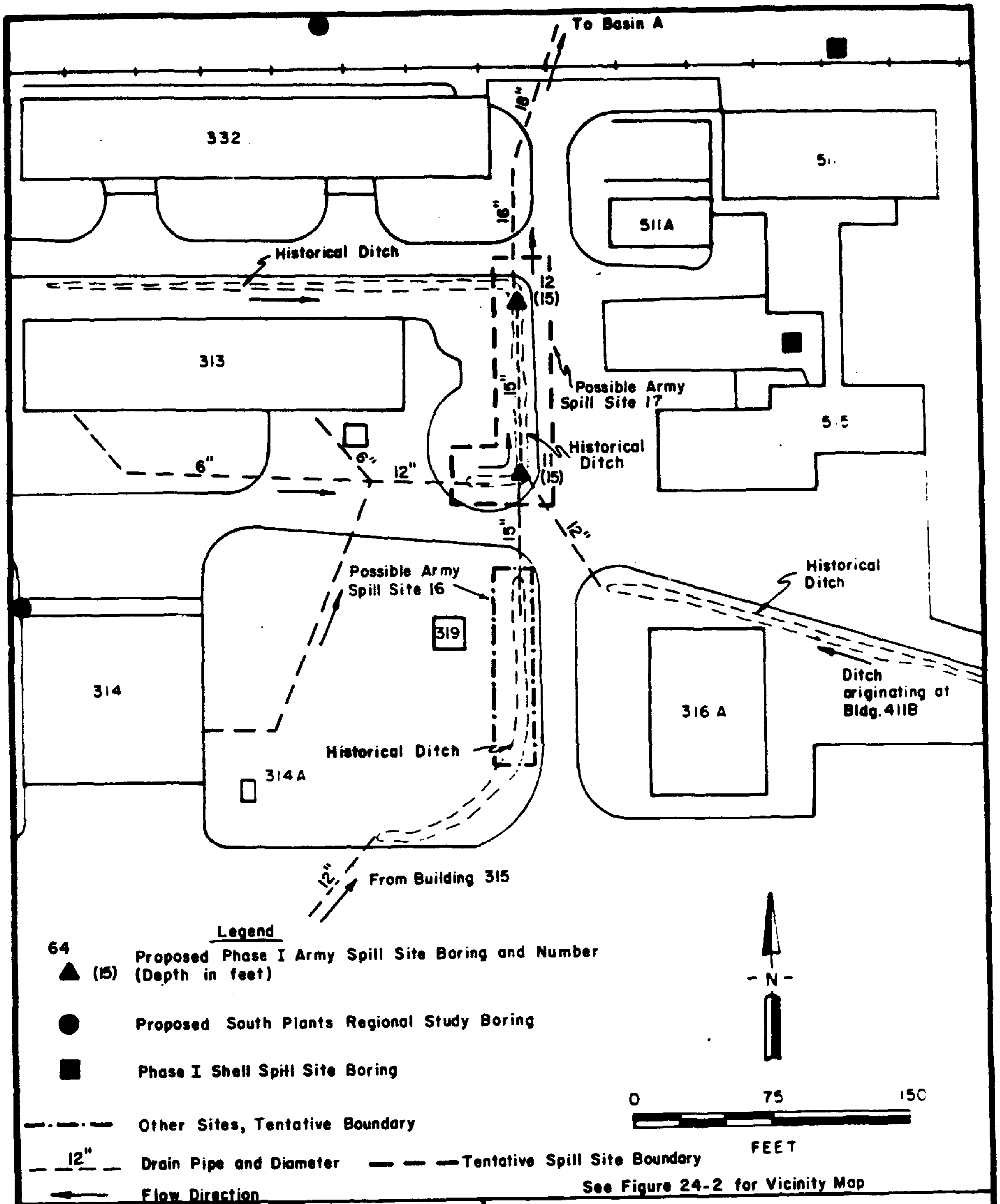

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FIGURE 24-17
Boring Location Map
Army Spill Site 17, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 18:
Small spills of petroleum products, paints, thinners, and solvents were reported in and around the maintenance shops (Buildings 543, 543B, 544, and 545); see Figure 24-2. The exact nature, location, and dates of these spills have not been reported (Kuznear & Trautmann, 1980; Shell, 1985).

Field reconnaissance of this site indicated that there are ground stains and mounded material along the southern edge of the loading dock and foundation of Building 543. No other evidence of spills was noted.

One boring is proposed to investigate the ground stains. This boring (37) will be located within a stained area (see Figure 24-18) noted during the field reconnaissance. This boring will be drilled to the water table (anticipated to be at 15 ft below the ground surface in this area). Samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. A grab sample (36) will be obtained from mounded material (Figure 24-18). Samples from the borings within this spill area will be analyzed for the standard suite of Phase I analytes. The grab sample will be analyzed for the standard suite of Phase I analytes with the exception of volatiles. See Section 4.0 for a more detailed discussion of analytical methods.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	15	4	Phase I Analytes
1 (grab sample)	Surface	1	Phase I Analytes (no volatiles)

The area of Spill Site No. 18 is quite large, encompassing many areas where spills potentially could have occurred. A soil gas screening program is proposed for this site to aid in effective location of additional borings to investigate the nature and extent of soil contamination. The substances that potentially were spilled within this area include petroleum products, paints, thinners, and solvents, which are detectable through use of the soil gas screening technique. If "hot spots" are located through the use of the soil gas screening technique, borings can be located in areas where they are most likely to add information in defining the nature and extent of soil contamination at the site. In addition, data from the soil gas screening will aid in determining the lateral extent of the spill area so that the volume of potentially contaminated soil at the site can be estimated. Previously undocumented spill areas at the site may also be located using the soil gas screening technique.

A grid pattern will be used to place the sampling tubes for soil gas extraction, and the grid pattern will be supplemented as necessary by placing additional sampling points in suspect areas such as low spots, drainages, stained areas, tanks, sumps, or near pipes. See Section 4.2.3 for a complete description of this soil gas method. The study consists of 62 individual sampling locations. A 50 ft spacing was initially used in forming the grid. Sampling points were then added around the perimeters of buildings to detect potential contamination that may have escaped from the buildings. Sampling density was increased along the railroad tracks by reducing the spacing distance in the north-south direction. This was done because of the higher probability for spills to occur in this area, and the presence of spill evidence in the form of ground stains.

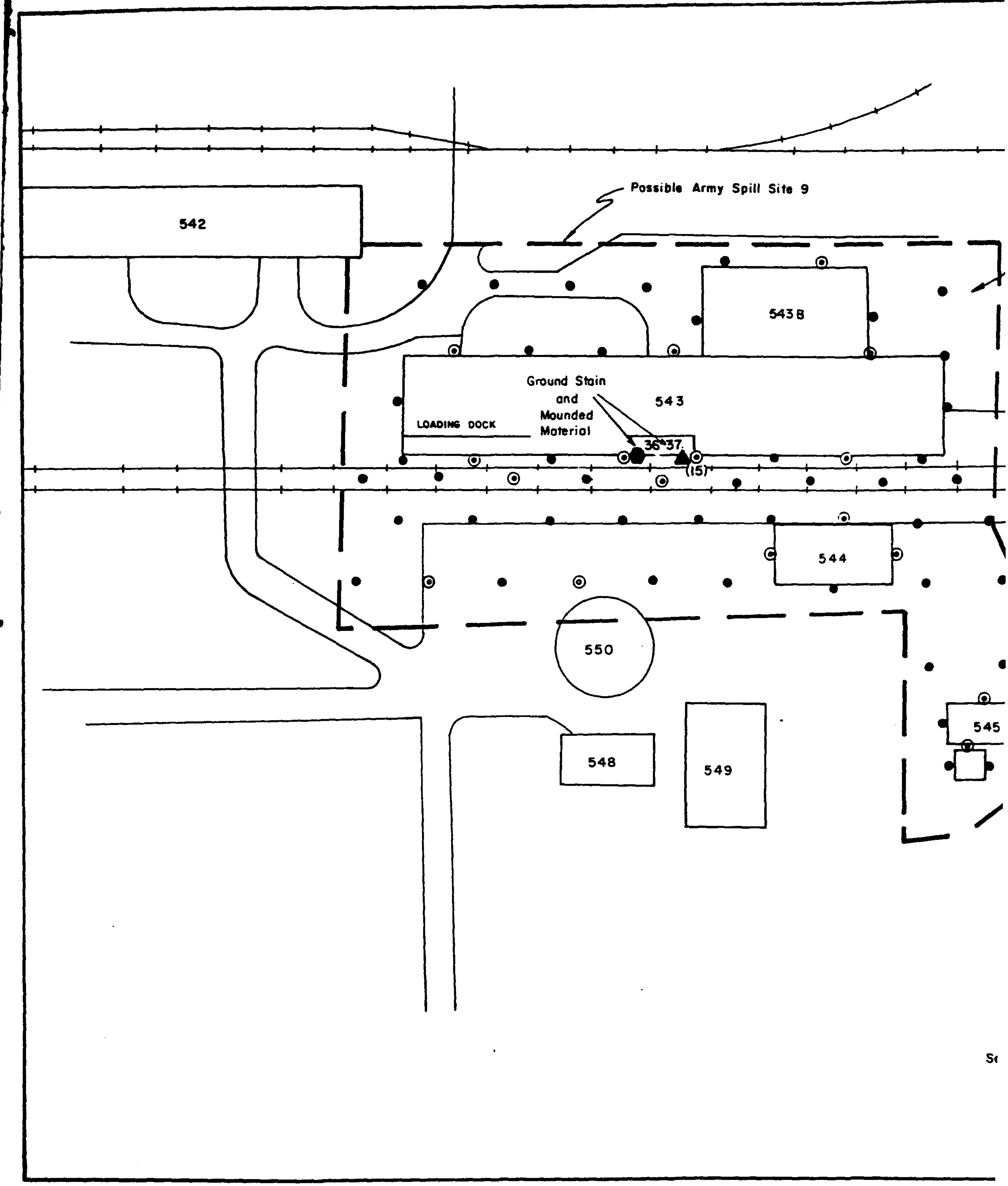
All 62 sample points within the soil gas study area will be analyzed for a set of specific compounds which are commonly present in petroleum products, paints, thinners and solvents. This set includes benzene, toluene, total xylene, alkanes, methyl ethyl ketone, ethylbenzene, and total volatiles.

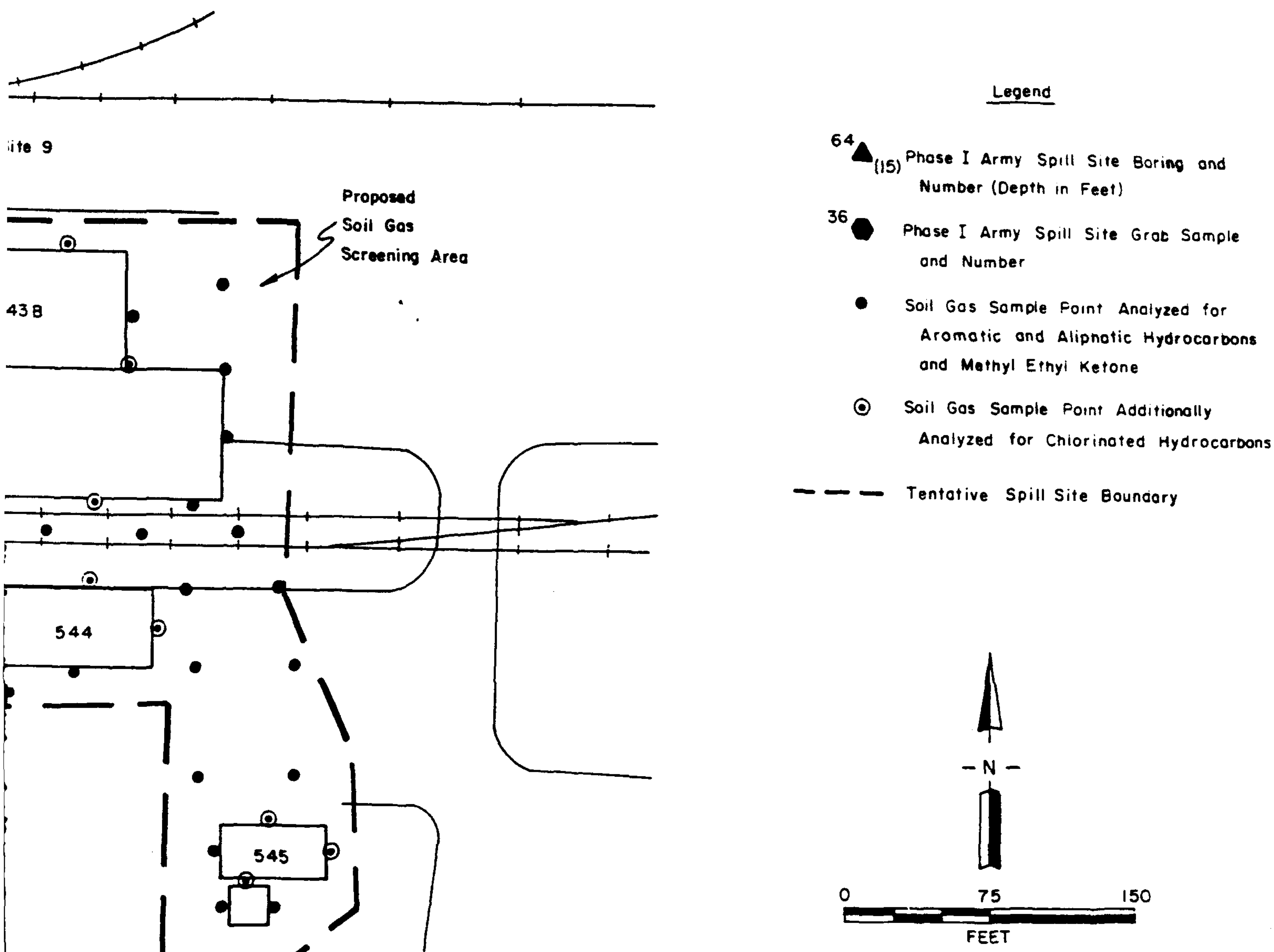
Additionally, 18 sample points within the soil gas study area will be analyzed for chlorinated hydrocarbons using a gas chromatograph equipped with an electron capture detector. The preliminary literature search has not identified specific instances of chlorinated hydrocarbon use in this area, but documented maintenance activities at this site suggest the possibility of their use. Areas with a relatively high probability of detection of chlorinated hydrocarbons were selected for additional analysis. Ten of the sample points chosen for the additional analyses are near the perimeters of buildings, where spilling or leakage may have occurred. Six of sample points selected are within the loading dock area, where spills may have occurred during loading and unloading. Three additional sampling sites were also selected in areas located away from buildings to establish a baseline control for the results.

After the results of the soil gas sampling are obtained and are analyzed, soil borings will be placed as necessary to characterize the nature and extent of soil contamination at the site.

Additional research has also shown that Building 544 contained the RMA pest control shops from the mid-1950s until 1979. It served the combined functions of a pesticide mixing room and office. Only a few drums containing pesticides were actually stored in this structure. The main storage area was part of an outdoor storage shed housing tractors, pesticides, disposal equipment, and mowing machinery. It is believed that this shed is Building 545, constructed in 1953. The pesticide storage section of this shed was enclosed on all sides with perforated steel planking (PSP) to include the dirt floor. During an installation pest management program survey conducted between October 6 and October 9, 1975, it was noted that the dirt floor appeared thoroughly saturated with pesticides. Prior to mechanized spraying operations, pesticides were pumped from drums to a storage tank on the sprayer outside of Building 544. Water or kerosene was mixed with the pesticide in the sprayer's storage tank. What pesticide mixing occurred inside Building 544 is unknown, but it is assumed that it involved smaller scale operations USAEHA, 1975; PMCDIR, 1977; Lynes, undated). Pesticides stored in Building 544 included organochlorine pesticides, organophosphorous pesticides, and organic sulphur compounds. A complete listing of pesticides stored in Building 544 is available for October 6, 1975, and February 7, 1979, and can be found in Appendix A (U.S. Army Environmental Hygiene Agency, 1975).

Field reconnaissance yielded no evidence of possible spills or leaks or areas of likely contamination. The floor of Building 545 is concrete and does not appear large enough to store the above listed equipment. Results of the soil gas survey will be combined with information gained in the Task 24 Structure Survey to assess the need for borings in this area.


Possible Army Spill Site 9
542
543 B
543
Ground Stain
and
Mounded
Material
LOADING DOCK
36 37
(15)
544
550
545
548
549



See Figure 24-2 for Vicinity Map

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FIGURE 24-18
Soil Gas Screening Area and Boring Location Map Army Spill Site 18, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 19:

Small spills of organochlorine compounds, degreasing solvents, paint strippers, rust removers, paints, thinners, and other solvents have been reported in and around the heavy industrial equipment renovation facilities in Building 751 (see Figure 24-2). Building 751 is currently in use. The exact nature, location, and dates of these spills are not known (Kuznear & Trautmann, 1980; Shell, 1985).

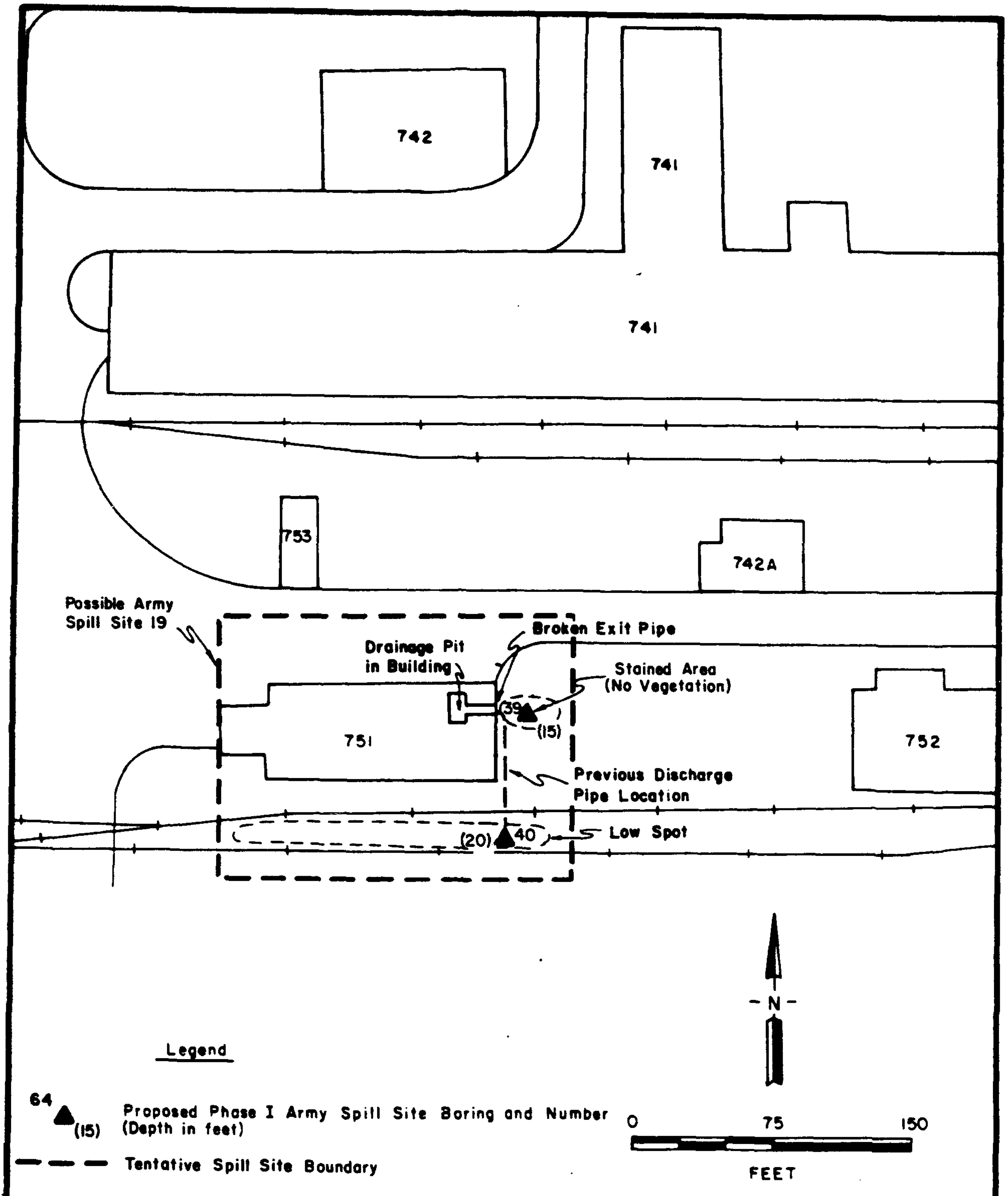
Field reconnaissance of this spill area revealed indoor trenches in Building 751, draining toward the east end of the building, where a drain exits the wall of the building. The drainpipe through the wall was previously connected to a vitreous clay pipe, which ran south from the building and emptied into a low spot between the railroad tracks running along the south side of Building 751. The vitreous clay pipe is broken, and any drainage from the building now dumps onto the ground at the east end of the building. Stressed vegetation was noted in the area where this drainage now collects. No other evidence of spills was noted.

Two borings are proposed for this spill area (see Figure 24-19). One boring (39) will be located in the area where drainage from the building would now collect; it will be drilled to 5 ft above the water table (anticipated to be at 20 ft below the ground surface in this area), for a total depth of 15 ft. Samples will be taken from the standard intervals to 20 ft.

The second proposed boring (40) will be located in the ditch between the railroad tracks, where the vitreous clay pipe discharged before it was broken. This boring will be drilled to the water table (anticipated to be at 20 ft below the ground surface in this area). Samples will be taken from the standard intervals to 20 ft, and (if necessary) subsequently at 10 ft intervals. Samples from the borings within this spill area will be analyzed for the standard suite of Phase I analytes. See Section 4.0 for a more detailed discussion of the analytical methods.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	15	4	Phase I Analytes
1	20	5	Phase I Analytes



See Figure 24-2 for Vicinity Map

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FIGURE 24-19
Boring Location Map
Army Spill Site 19, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 20:

On November 16, 1981, an unknown quantity of an unknown liquid was observed leaking from a caustic tank located east of Building 536 (see Figure 24-2). The liquid flowed south under the fence, following the existing surface grade, and into a drainage ditch heading west (Shell, 1985; Pimple, 1981). The drainage ditch was dammed to contain the flow which was characterized by RMA Fire Department personnel as "slight enough to warrent leaving 'as is' pending notification of plant operations personnel when they report(ed) to duty (two hours after the incident's discovery)." The caustic tank was checked and no apparent leaks were discovered in the tank or piping (Fire Department, 1981). Building 536 is within the former mustard production complex.

Two borings are proposed for this spill area (see Figure 24-20). One boring (18) will be located at the south end of the tank east of Building 536. This boring will be drilled to the water table (anticipated to be at 10 ft below the ground surface in this area). Samples will be taken from the standard intervals to 10 ft. The second boring (19) will be located in the ditch where the liquid reportedly drained and will also be drilled to the water table (anticipated to be at 10 ft below the ground surface in this area). Samples will be taken from the standard intervals to 10 ft; and (if necessary) subsequently at 5 ft intervals. Samples from both borings in this spill area will be analyzed for mustard breakdown products using the thiodiglycol method. In addition, samples from Boring 19 (located in the ditch, which is a low point near the site) will be analyzed for the standard suite of Phase I analytes to determine if previously unidentified contamination may be present at the site. See Section 4.0 for a more detailed discussion of the analytical methods.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	10	3	Thiodiglycol
1	10	3	Phase I Analytes Thiodiglycol

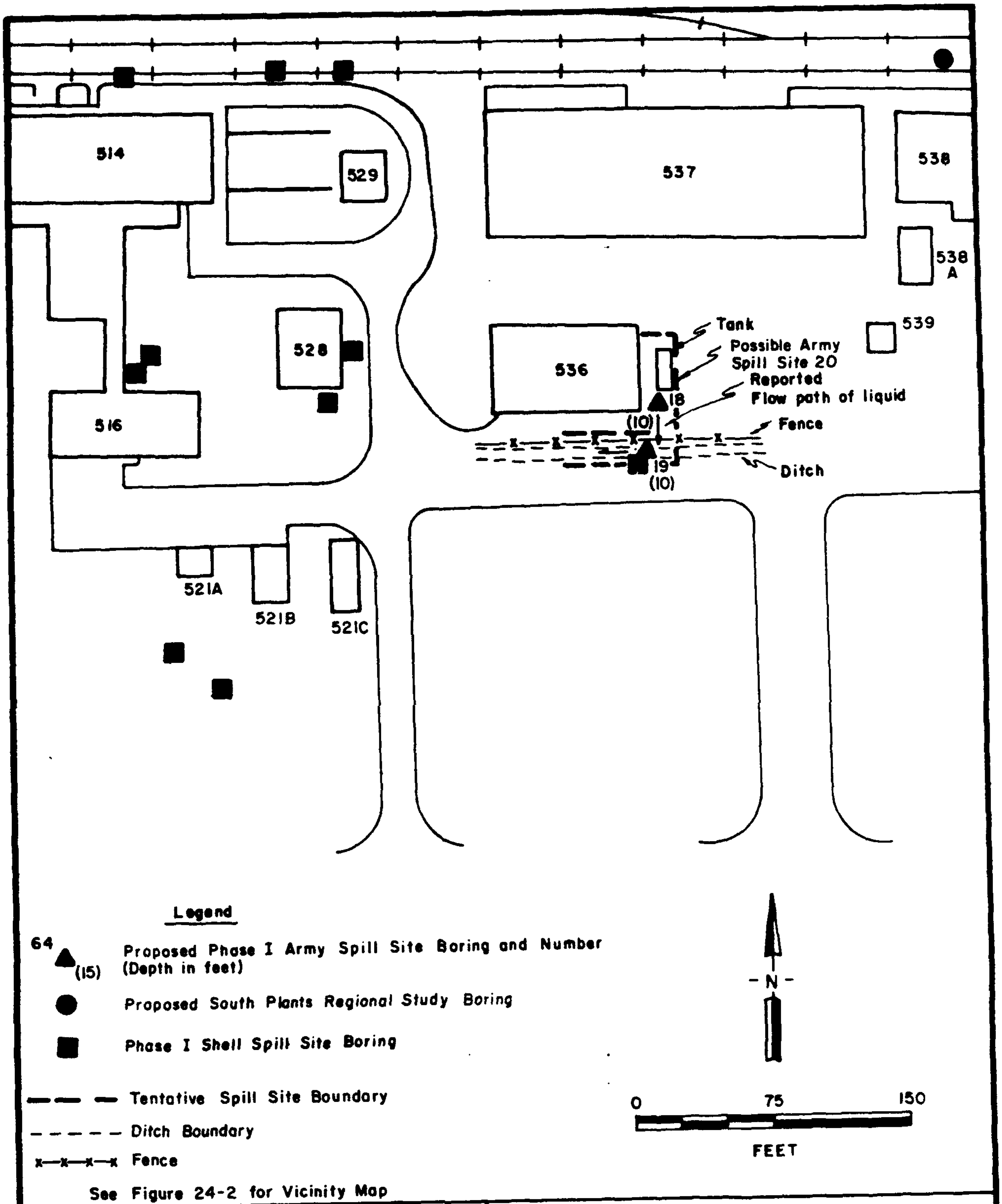

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FIGURE 24-20
Boring Location Map
Army Spill Site 20, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 21:

No spill site corresponding to this number was listed in the Shell documents (Shell, 1985). Therefore, this spill will not be investigated under Task 24 (Spills).

Spill Site No. 22:

A 1,200 lb mustard spill (previously reported by Shell as a mercury spill; Shell, 1985) reportedly occurred in the mustard thaw and unload area of Building 537 on July 23, 1973 (Scherbath, 1986), at 0015 hours, during start-up of the mustard facility. Two personnel performing first entry monitoring of the thaw room in Building 537 observed that mustard had leaked around one of the valves of a ton container. All the agent was observed to be contained in the thaw room. The estimated 1,100 pounds of agent spilled on the floor and aprayed on the walls was decontaminated by crews working in relays. STB slurry was used to decontaminate surface accumulations. The bulk of the agent was covered with STB and subsequently hosed into the thaw room ventilating trench. After the addition of more bleach and after steam sparging, the agent-containing solution was pumped to the Building 536 brine storage tank. Caustic was added to the storage tank and to the trench. The brine storage tank was recirculated until QA laboratory analytical results showed no agent contact in the brine. The material was then spray dried. The affected container was taken to the unloading booth, drained, and removed to Building 538 for incineration. There were no exposures, and the plant was back in operation at 1600 hours on the same day (PMO, 1975).

Since this spill was reportedly contained within the building and cleaned up, no soil borings are proposed. Evidence of contamination within the building will be researched under Task 24 as part of the structure survey for the South Plants area.

Spill Site No. 23:

No spill site corresponding to this number was listed in the original Shell documents (Shell, 1985). Therefore, this spill will not be investigated under Task 24 (Spills).

Spill Site No. 24:

Mercury was reported to have been spilled around Building 534 during orsate sampling of acetylene between 1948 and 1975 (PMCDIR, 1977). However, D.L. Way, referenced in the PMCDIR report, stated in his interview during the preparation of this report that the mercury was spilled around Building 534A between 1948 and 1975 (Leibel, 1976). Mercury was employed in the orsate instrument to withdraw a sample of acetylene into a sack where it was apparently tested in order to insure that the acetylene was free of oxygen prior to the compression of acetylene gas (Donnelly, 1985f; Way, undated-a). Julius Hyman Company and Shell produced acetylene at RMA between 1950 and 1974, utilizing the gas as a raw material (together with cyclopentadiene (CPD)) in the production of bicycloheptadiene (BCH), an intermediate in the production of aldrin (Shell, 1952a). Hyman and Shell produced acetylene from calcium carbide and water in Building 459, and stored the acetylene gas in acetylene gas holders, Buildings 434 and 435. The acetylene gas was then conveyed through overhead piping to Building 561A, where it was stored in Tank T-300. In Building 561A, the acetylene was compressed and pumped to Building 561, the BCH Unit, where it was mixed with CPD in order to form BCH (M-101) (Shell, 1952b). Building 561A was located adjacent to Buildings 534 and 534A. Buildings 534 and 534A were not used by Shell until 1966, the former as tankage, pumphouse, and storage areas in support of the planavin nitration unit in Building 534B, and the latter as a planavin unit shift shack (maintenance equipment storage, field shop, and foreman's office) (Shell, 1952b). It is, therefore, likely that, while the location of Shell's orsate sampling described by Dr. Way is generally accurate, the reported mercury spills were actually associated with Building 561A.

Seven Task 2 borings have been drilled around Buildings 534 and 534A (Figure 24-21). Analytes detected within or above indicator levels include aldrin, dieldrin, isodrin, methylisobutyl ketone, o- and p-xylene, m-xylene, ethylbenzene, chlorobenzene, arsenic, mercury, copper, p-chlorophenylmethyl sulfone, and zinc. One Task 2 boring was drilled approximately 75 ft east of Building 561. Analytes detected within or above indicator levels in this boring include aldrin, chlordane, dieldrin, endrin, isodrin, methylene chloride, chloroform, arsenic, mercury, and lead. Additionally, Boring 5 (Spill Site No. 2 of this report) will be drilled approximately 25 ft northwest of Building 561.

Due to the small amounts of mercury suspected in orsate sampling and the lack of detailed data on exact spill locations, it is unlikely that additional soil borings in this area would detect the possibly spilled mercury. Therefore, no additional borings are proposed under Task 24.

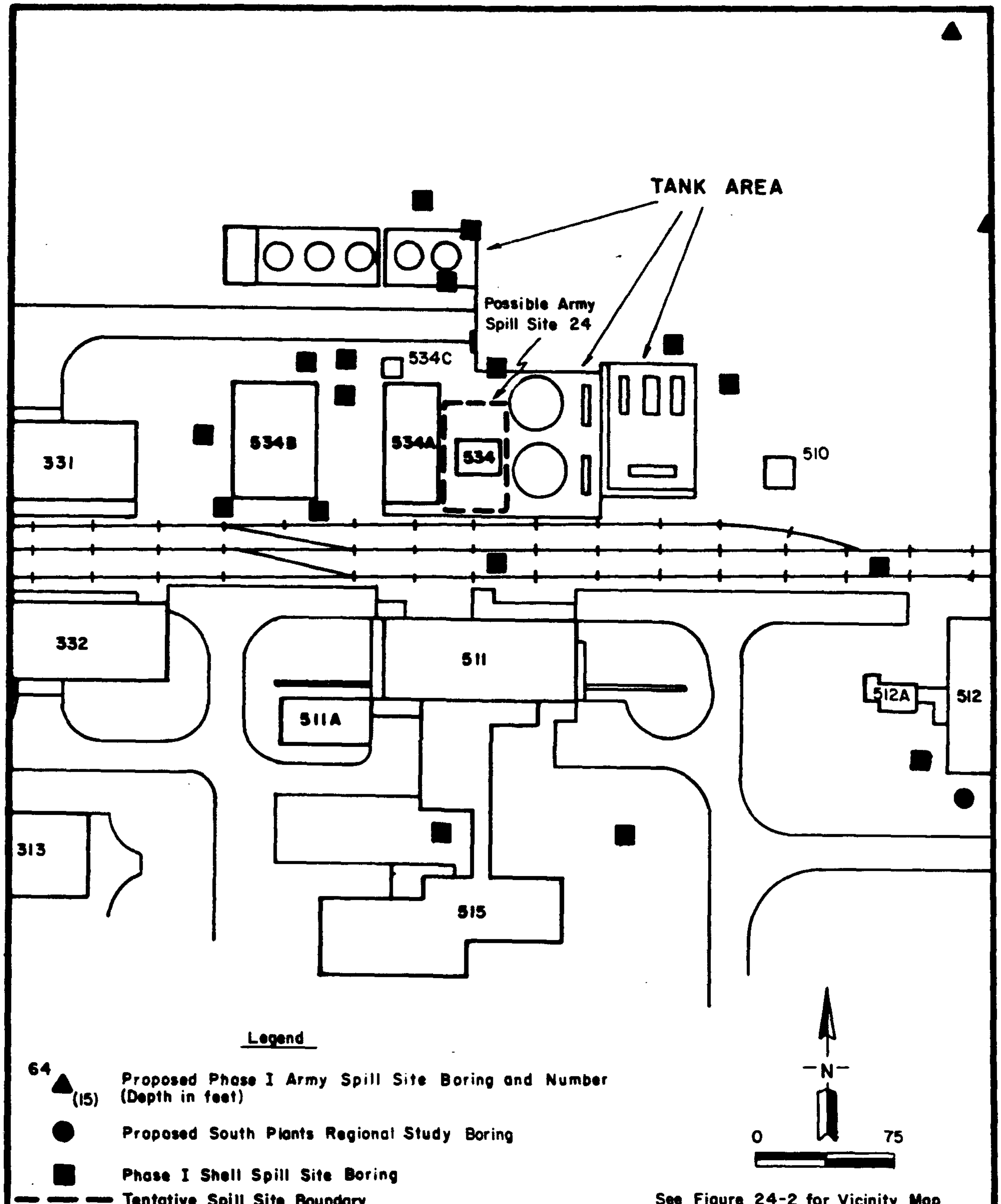

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FIGURE 24-21

Boring Location Map

Army Spill Site 24, Section I

Rocky Mountain Arsenal, Task 24

Prepared by: Ebasco Services Incorporated

Spill Site No. 25:

The white phosphorous cup filling plant was operational in 1945 and between 1951 and 1957. During this same period, white phosphorous was also utilized for the filling of AN-M19 igniters, M-78 and M-79 incendiary bombs, M-15 grenades, and M-23A1. The WP cup filling plant consisted of eight buildings: cup filling and assembly Building 522, cup testing and storage Buildings 521 and 541, WP storage and pump Buildings 523A and 413, warehouse Building 542, phossy water storage tank and condensate pump warehouse Building 522A, and administration, locker and supply Building 517. Buildings 522 and 541 were connected by an enclosed passageway. Reinforced concrete trenches ran between Buildings 522 and 523A, and between Buildings 523A and 413 (RMA, 1945j). WP munitions filling took place in Building 523 (Donnelly, 1985g).

In 1960, 1966, 1968, 1969, and 1970, there were no cup-filling activities, but white phosphorous was utilized for the filling of M-24 and M-34 grenades, and 105mm shells (History of RMA, 1945-1970; white phosphorous inventory, 1969-70). Process water from the cup-filling and munitions filling facilities, Buildings 522 and 523, which came in contact with white phosphorous, called phossy water, was discharged from those two buildings. Phossy water was produced when water was used to: (1) keep white phosphorous covered in its storage tanks; (2) unload white phosphorous tanks by the displacement method; or (3) preheat white phosphorous liners in the pipe trench before pumping white phosphorous to the filling tank (Thompson, 1950; Donnelly, 1985g; Leonard, 1952; Estes, 1949; Grasser, 1954; Murphy, 1960; Hendershot, 1968). Because of the use of Catalin cups in 1945, denatured alcohol was present in the WP cup filling plant effluent in that year only (Donnelly, 1985h). Additionally, the contents of copper sulfate coating tanks in Building 522 were disposed of approximately once each month (Digregario, 1986). In 1945 only, this copper sulfate solution contained sodium acetate (RMA, 1945m; RMA, 1951).

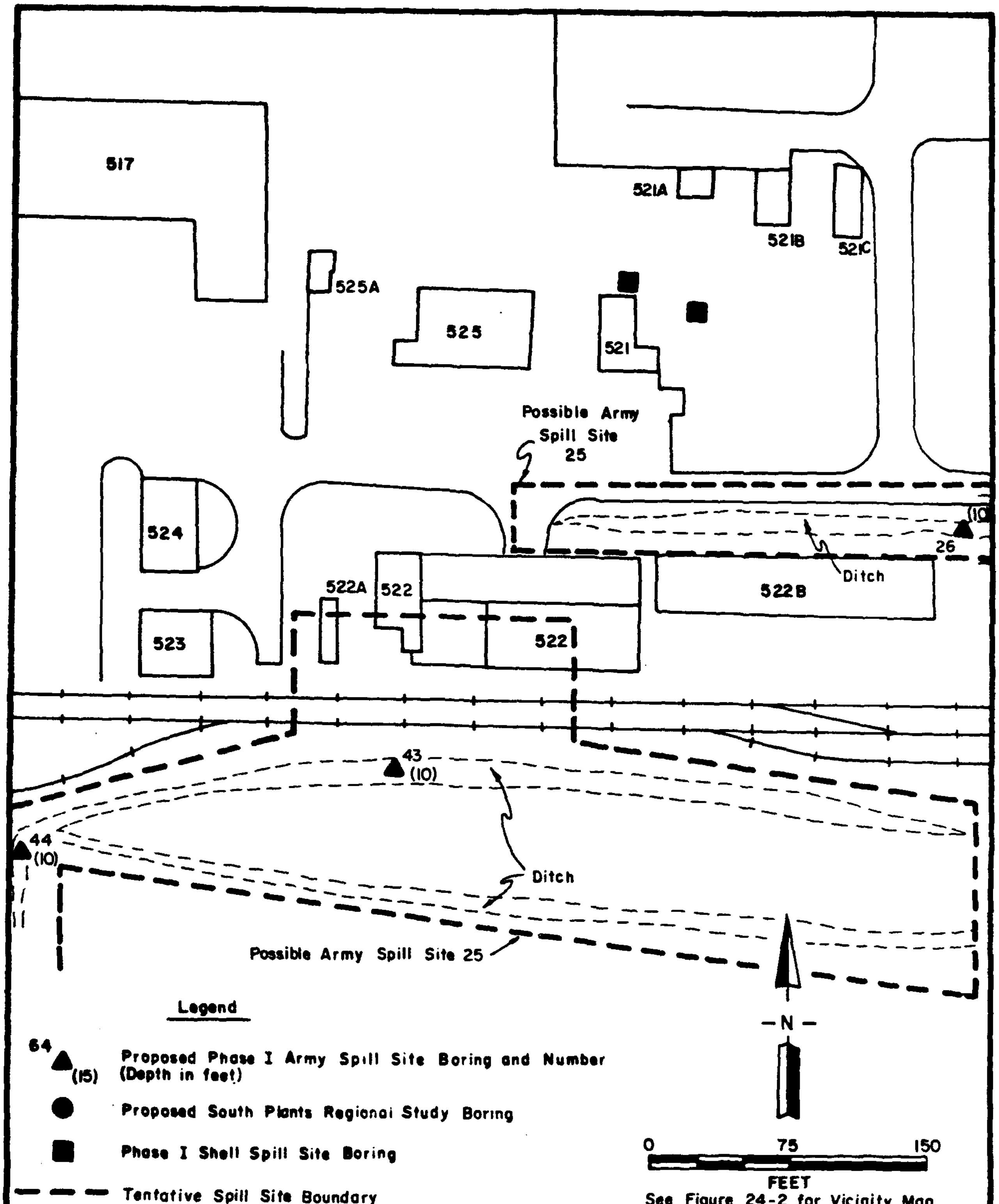
In 1945, waste water from the white phosphorous plant was disposed by discharge through the chemical sewer line to Basin A. Between 1951 and 1970 based on the Army's conclusion that "phossy water" could not be discharged through the sewer due to its potential to react violently with hydrocarbons discarded by lessees, the waste was discharged to a drainage ditch south of the plant which extended through the South Plants area to Sand Creek Lateral (Donnelly, 1985i; RMA, 1951; RMA, 1945l). Another ditch where phossy water may have been discharged is north of Building 522B (Shell, 1985; USAEHA, 1960).

One boring (26) is proposed for the northern portion of this spill area (see Figure 24-22), located in the surface water drainage which may have carried the phossy water in an area betwe·n and north of Buildings 522B and Building 541. This boring will be drilled to the water table (anticipated to be at a depth of 10 ft below the ground surface in this area). Samples will be taken from the 0 to 1 ft, 4 to 5 ft, and 9 to 10 ft intervals. Two borings (43 and 44) will be located in the southern portion of this spill area, in the ditch system south of Buildings 522 and 522B that may also have carried phossy water. These borings will also be drilled to the water table (anticipated to be at a depth of 10 ft below the ground surface). Samples will be taken from the 0 to 1 ft, 4 to 5 ft, and 9 to 10 ft intervals.

Phosphates are a naturally occurring or a pre-existing compound likely to be found in the soils in this area, and are not necessarily indicative of process phosphorus contamination, so no analyses will be conducted for phosphates. However, since these ditches received process wastewaters, samples from the borings within this spill area will be analyzed for the breakdown products of mustard using the thiodiglycol method, and for the breakdown products of lewisite using the organoarsenic method. Additionally, samples from these borings will be analyzed for the standard suite of Phase I analytes to determine if any previously unidentified contamination may be present. See Section 4.0 for a more detailed discussion of the analytical methods.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
3	10	9	Phase I Analytes Organoarsenic Compounds Thiodiglycol



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Aberdeen Proving Ground, Maryland

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FIGURE 24-22

Boring Location Map
Army Spill Site 25, Section I
Rocky Mountain Arsenal, Task 24

Prepared by: Ebasco Services Incorporated

Spill Site No. 26:

Phosgene gas leaks were reported during the bomb filling operations in Buildings 331 and 332 (Figure 24-2) in 1944. Filled bombs were leak tested in booths within the buildings, and fumes were vented through caustic scrubbing towers. Calcium chloride brine was used as a refrigerant in coolers which chilled liquid phosgene before it was filled into bombs (RMA, 1945 (n)). Hence, calcium chloride was present in the phosgene plant effluent. Also, during cold weather, 50% caustic, rather than 17%, was pumped to the phosgene filling plant for use in the scrubbers. On several occasions, water had to be used in the scrubbers instead of caustic because the 50% solution clogged the transfer line. Phosgene is slightly soluble in water, but is also hydrolyzed by it, as follows:

$$COCl_2 + H_2O \longrightarrow 2HCl + CO_2.$$

Army personnel found it necessary to continually flush the scrubber system with water and add fresh water to prevent corrosion by the hydrochloric acid (RMA, 1945o). Therefore, some hydrochloric acid was probably discharged to the chemical sewer from the operation of the phosgene filling plant. Effluent generated from the refrigeration system, the scrubbers, and from the painting of bomb casings (water containing naptha, paint thinner, and oils) was discharged from the plant through the contaminated sewer to Sand Creek Lateral (RMA, undated; Donnelly, 1943; Kuznear & Trautmann, 1980).

Liquid wastes were discharged to the chemical sewer, and there are no reports indicating that these wastes escaped the confines of the buildings or were discharged to the soils outside the buildings. Phosgene is a gas, and it is unlikely that leaks that may have occurred within the buildings would be detected by a soil boring program. No soil borings are planned as a part of of the Task 24 (Spills) investigation. Evidence of contamination within the buildings will be researched as a part of the Task 24 structure surveys.

Spill Site No. 27:

Lead azide is reported in one source to have been spilled within Buildings 362 and 365 (see Figure 24-2), in unknown amounts at unknown dates. All spills were reportedly contained within the buildings; the lead azide likely was disposed to the floor drains (Shell, 1985; PMCDIR, 1977). Additional research has shown that the manufacture of mines utilizing lead azide, in fact, occurred in Buildings 1601 and 1606 in North Plants (RMA, June 1967; RMA, August 1967). (Information on these buildings can be found in the Task 42 Technical Plan (Ebasco, 1987).

Buildings 362 and 365 were used for the production of sandwich button bombs between 1966 and 1967. Red phosphorous, magnesium oxide, and potassium chlorate were combined in the appropriate amounts in Building 365. The bombs were then assembled in Building 362. (Sandwich button bombs were used as audible warning devices which would explode when disturbed by moving troops or equipment.) (Walker, 1967; RMA Drawing No. 16-01-10; RMA, 1942-1947; RMA, 1967).

No evidence of spills was observed outside Buildings 362 and 365; no Task 24 borings are planned for this alleged spill area. However, several borings are planned around Buildings 1601 and 1606 under Task 42. Evidence of contamination within these buildings will be researched as a part of the structure surveys (Task 24).

Spill Site No. 28:

Red phosphorus was reportedly discharged to drains in Buildings 362 and 365 (see Figure 24-2), in unknown quantities and on unknown dates. The spills were contained within the buildings (Shell, 1985; PMCDIR, 1977).

No evidence of spills was observed outside Buildings 362 and 365, so no borings are planned for this spill area. Evidence of contamination within these buildings will be researched as a part of the structures surveys for the South Plants area (Task 24).

Spill Site No. 29:

Between April and November of 1943, during the production of arsenic trichloride, arsenic sludge was discharged to the M-1 settling basins. There was a settling basin outside Building 523, which is now covered by an expansion of Building 523 (see Figure 24-23) (Whelman, 1943). There is no information in the literature indicating that the settling basin was ever used by the Army (Ebasco, 1986e).

The location of the single boring (30) (Figure 24-23) proposed for this site will be within or as near as possible to the former settling basin. This boring will be drilled to the water table (anticipated to be at 10 ft below the surface in this area). Samples will be taken from the standard intervals to 10 ft. Samples from the boring within this spill area will be analyzed for the standard suite of Phase I analytes. This information will indicate if the basin was used and if it leaked. See Section 4.0 for a more detailed discussion of the analytical methods.

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	10	3	Phase I Analytes

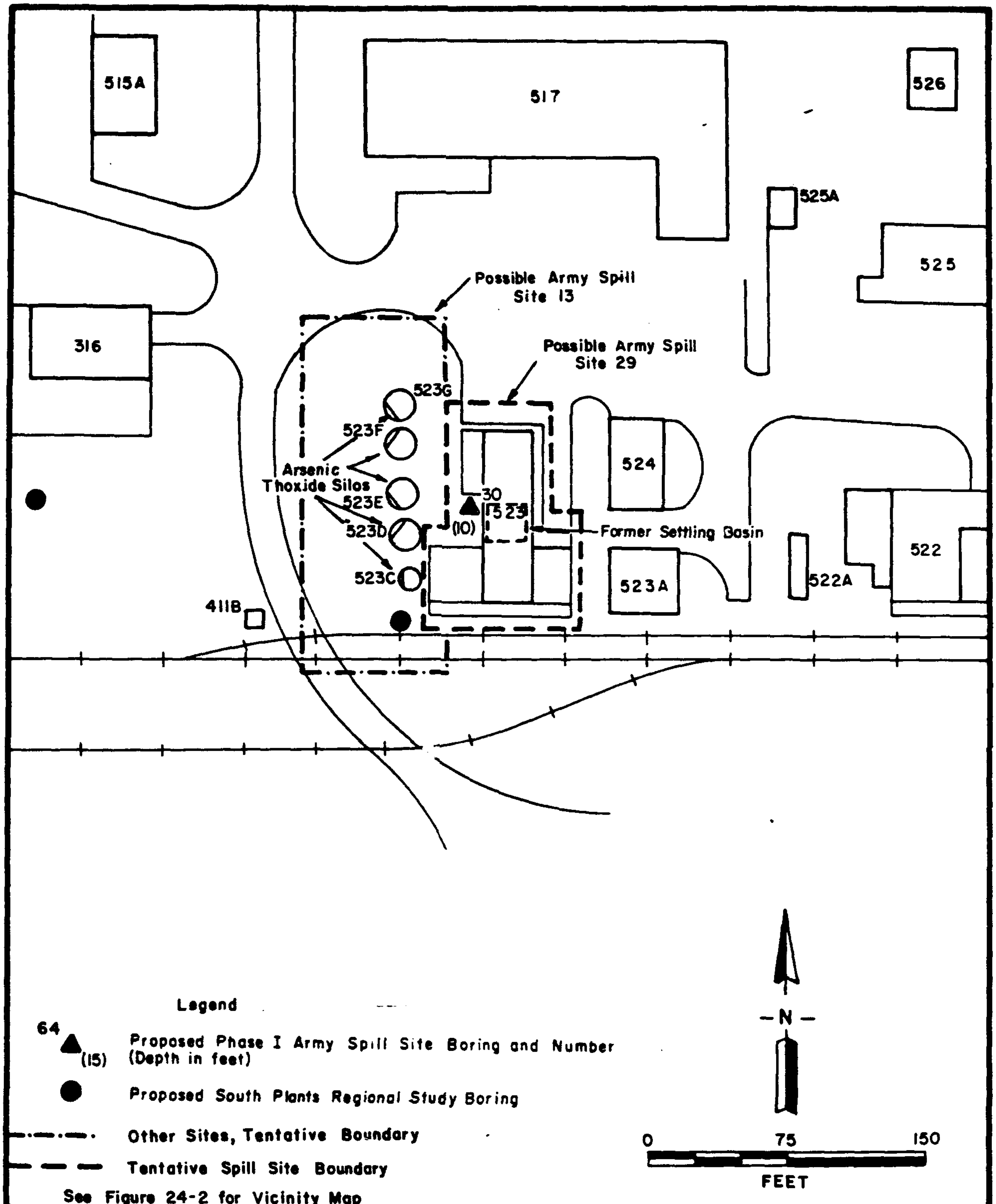

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FIGURE 24-23
Boring Location Map
Army Spill Site 29, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 30:

On March 31, 1952, an RMA switch engine, in the process of attempting to hook together two Hyman-leased chlorine tank cars adjacent to Building 252, accidently pushed these cars against another Hyman-leased chlorine car being loaded by Hyman with chlorine at the chlorine plant track scale south of Building 252 and north of Building 321. This resulted in the breaking of the loading lines and the release of approximately 3,700 lbs of liquid chlorine and chlorine gas (Silber, 1952; Matheny, 1952; Smith, April 1952, June 1952, July 1952, April 1952, first through fourth endorsement, May 1952; Bejarano, 1952).

Several borings were placed in the vicinity of this spill site as a part of the Task 2 Phase I study at Site 2-8 (see Figures 24-2 and 24-24). The results of the analyses from these borings will be presented in the Site 2-8 Source Report when they are available. As the chlorine that was released was reportedly in the form of a gas, it is unlikely that the spill would be detected by a soil boring program. No soil borings are planned as a part of the Task 24 (Spills) investigation.

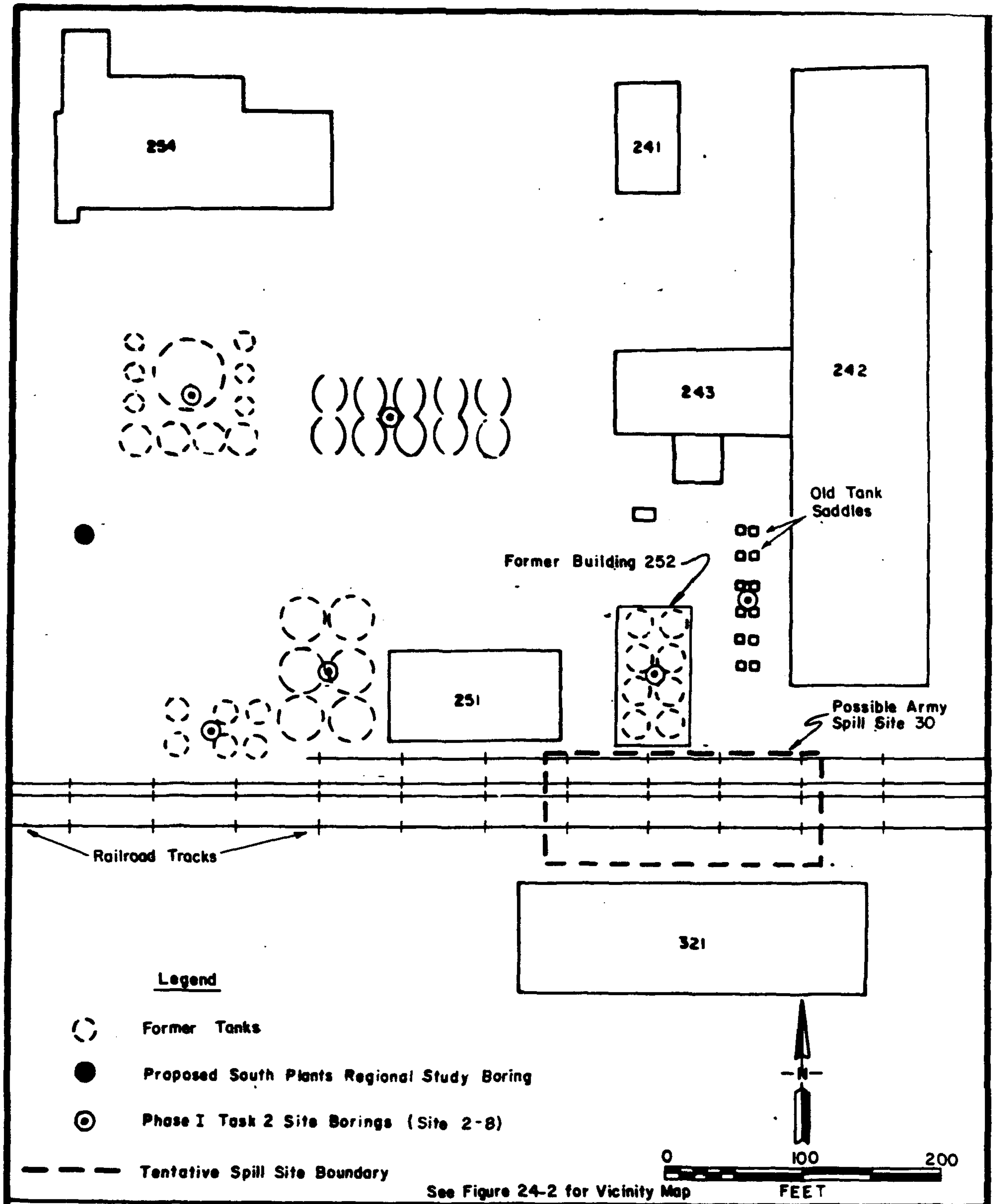

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FIGURE 24-24
Boring Location Map
Army Spill Site 30, Section I
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

Spill Site No. 31:

Tank car leaks or spills may have occurred at rail sidings where loading and unloading was done. The leaks or spills may have been due to leaky valves or fittings on the cars, or due to overfilling or accidental spills during the transfer of liquids (Kuznear & Trautmann, 1980). There is no information on the nature of these spills, or when or where they may have occurred. Where possible, South Plants Regional Study borings will be located to include track areas (see the South Plants Regional Study Letter Technical Plan; Ebasco, 1986e).

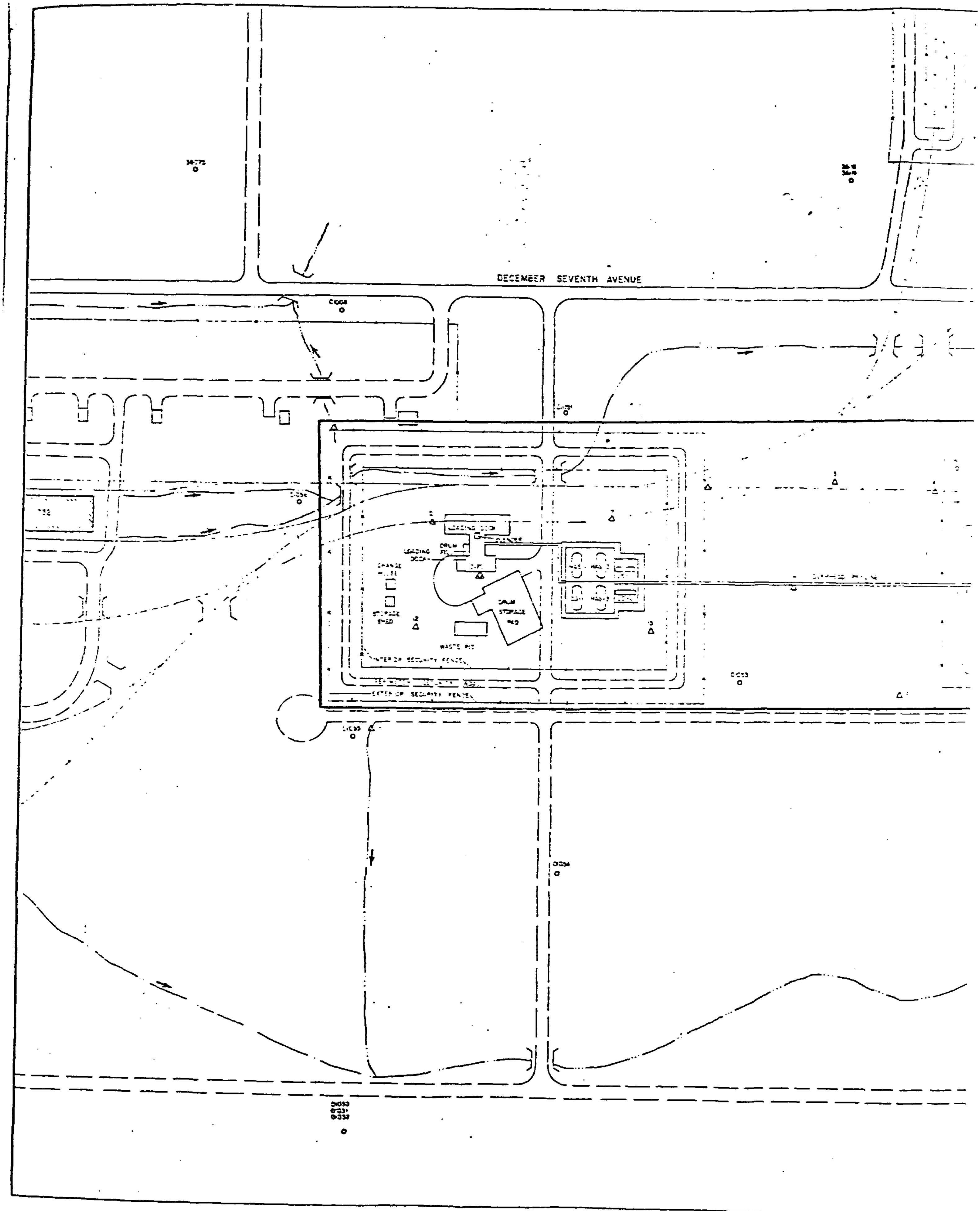
Spill Site No. 32:

In an area within the hydrazine facility (Figure 24-25), hydrazine drums were flushed with water at a rate of about about 50 drums per month during the late 1960s to mid-1970s. This washing was done on a concrete pad, and the water was channeled to one end of the pad. The wastewater then was drained into a waste pit, which was an in-ground concrete tank or sump (Employee interviews, 1985).

In addition to potential contamination caused by drum washing, another incident in this area has been reported. On the morning of November 22, 1975, RMA security patrol discoverd that UDMH storage tank US-4 (capacity 200,000 gal.), located at the east end of the hydrazine facility, was floating in liquid that had filled the concrete diked area surrounding the tank. The liquid was attributed to the fire protection system that had been tripped causing filling and overflowing of the diked areas around tanks US-3 and US-4. Nitrogen feed lines, vent lines, and other associated equipment was damaged. No damage to or leakage from tank US-4 was thought to have occurred, so the fire protection system was turned off and the diked areas were pumped out. The contents of both tanks were pumped into tank cars for temporary storage. A subsequent inventory discovered 2,000 lbs of UDHM apparently lost during the incident (Lovan, 1975; Esquibel, *undated-a*).

Potential soil contamination in and near the hydrazine facility is being investigated under Task 11. No Task 11 borings were drilled in the waste pit, as there was standing liquid in the tank. The standing liquid appears to be present on a constant basis, and will not be pumped out until the tank is prepared for removal. The standing liquid was sampled in February 1987 under Task 34. Information can be found in the Task 34 Preliminary Draft Final Report (Ebasco, 1987).

Several borings and wells have been placed in the hydrazine facility, in the vicinity of the above mentioned incidents under Task 11 (Ebasco, 1986). No additional borings are planned as a part of the Task 24 (Spills) investigation.


DECEMBER SEVENTH AVENUE
CHANGE HOUSE
STORAGE SHED
DRUM STORAGE PAD
WASTE PIT
LOADING DOCK
DRUM FILL
EXTERIOR SECURITY FENCE

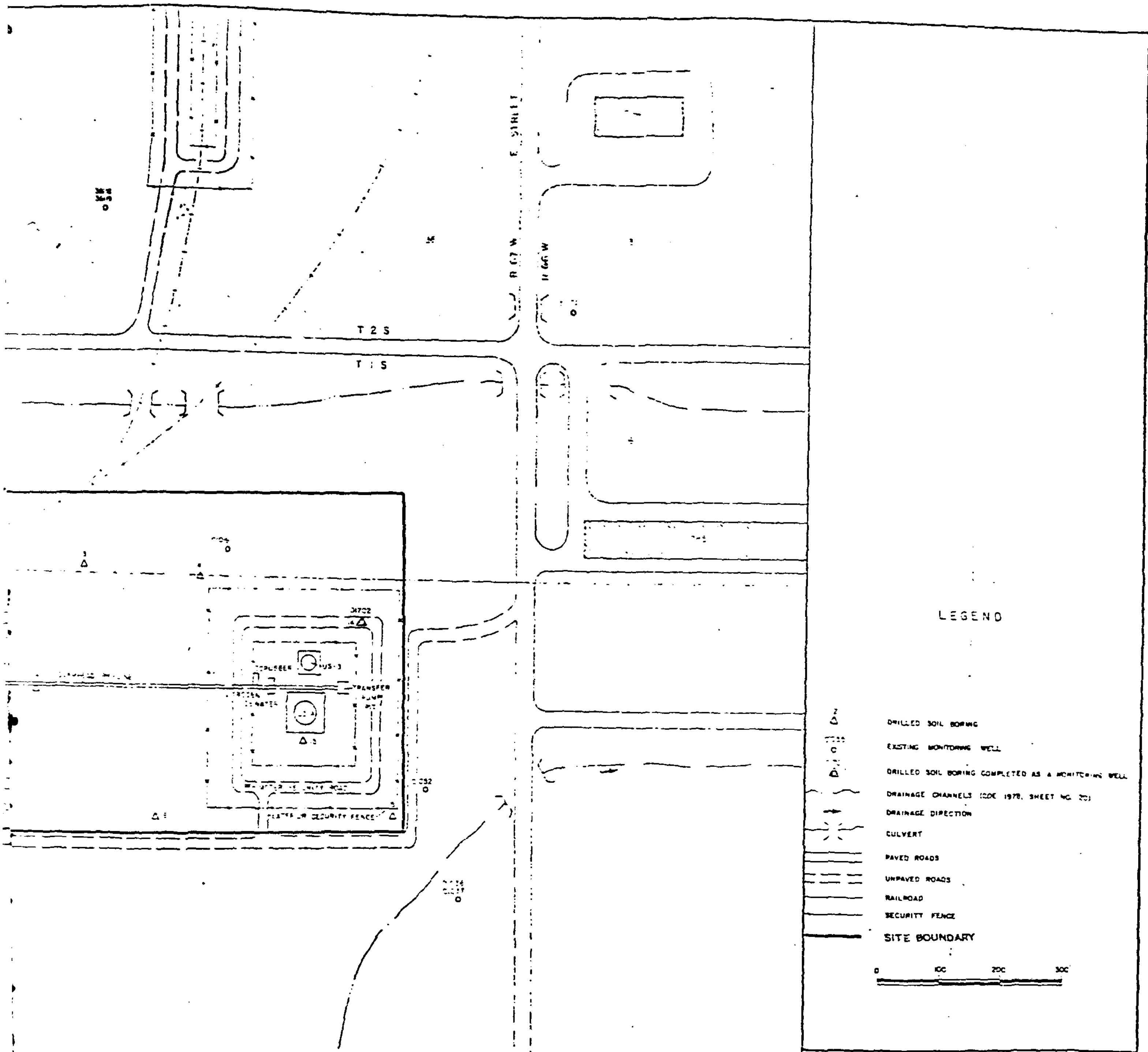


Figure 24-25

Army Spill Site 32, Section 1

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Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

Spill Site No. 33:

A mercury spill occurred in an instrument lab in Building 543, (Figure 24-2), on March 1, 1983. The spill involved a small amount of mercury which was cleaned up, and did not escape the immediate area of the spill (Giddens, 1983). Due to the small amount, to alleged containment, and the fact that the spill was cleaned up, no borings are proposed. Evidence of contamination within this building will be researched as a part of the structures surveys for the South Plants area (Task 24).

Spill Site No. 34:
An explosion occurred at the mouth of a charging hopper of acetylene generating unit no. 4, in the southeastern portion of Building 543 (Figure 24-2), on March 30, 1943 (Dupue, 1943). No information indicates that substances were spilled.

Since the spill occurred within the building, and information does not indicate possible escape to the ground of contamination, no soil borings are proposed. Evidence of contamination within this building will be researched as a part of the structure surveys for the South Plants area (Task 24).

Spill Site No. 35:

In Building 1501 (reported as "Building 501" in some references), an uncontrolled release of a "relatively large quantity" of GB occurred April 19, 1953. The GB spill was neutralized with caustic and the resulting mixture was stored in 55 gal. drums (Baird, 1953). Building 1501 is located in the North Plants and several borings are proposed around it under Task 42. The integrity of the structure will determine the need for, and location of, additional borings. If additional borings are needed they will be accomplished under Task 42. Evidence of contamination within this building will be researched as a part of the Task 24 structure survey.

Spill Site No. 36:

A spill of hydrofluoric acid allegedly occurred in Building 1501 in the North Plants area. The exact volume and location of the acid spill is unknown. Other spills may have occurred in and near the building (Cochran, 1985). No information is available on the locations, dates, or exact nature of spills in and near Building 1501. Several borings are proposed around this building under Task 42. The integrity of the structure will determine the need for, and location of, additional borings. If additional borings are needed they will be accomplished under Task 42. Evidence of contamination within this building will be researched as a part of the Task 24 structure survey.

Spill Site No. 37:

Building 742 (Figure 24-2) reportedly was used as an incendiary bomb plant. The use of paint thinners and lacquers may be associated with this site. This building was not connected to the chemical sewer system at the time that the building was in use as an incendiary bomb plant; wastes were carried from the building by a pipe which emptied into a ditch at the southeastern corner of Building 742 (Ebasco, 1986e). The ditch flows southeast, then angles north past the eastern side of the hydrazine facility, then heads east into Section 6. Approximately 600 ft into Section 6, the ditch again heads north, and terminates in a depression in Section 31, approximately 400 ft north of December 7th Avenue and 700 ft east of "E" Street (Stout & Abbott, 1982).

A spill to the ditch involving an unknown quantity of concentrated mixed acid (sulfuric and nitric) is recorded in the literature. The literature indicates that the acid spill was neutralized near the head of the ditch using sodium hydroxide (RMA, 1955). Additionally, the soils in the area are naturally slightly alkaline; this may have provided additional buffering or neutralization. Field reconnaissance by the Ebasco team yielded no trace of the spill; vegetation growing in and around the head of the ditch did not appear to be stressed. Given the nature and age of the spill, the reported neutralization of the acid, and the lack of any visible evidence of the spill, it is unlikely that traces of the acid spill are still present. No samples will be analyzed for residues of the acids.

In March 1980, a pest control shop had been constructed in Building 742 which met both Federal and Army standards. Any spillage during mixing was contained in the sinks within the building and discharged into an above-ground wastewater storage tank. The tank's contents were pretreated with a granular activated carbon and ion exchange system, and then discharged to the sewage treatement plant (USAEHA, 1979, 1980; IT Construction, 1984). In addition, herbicides, rodenticides, and pesticides were stored in Building 742 (Marlow, 1986). A list of these materials and their quantities can be found in Appendix B.

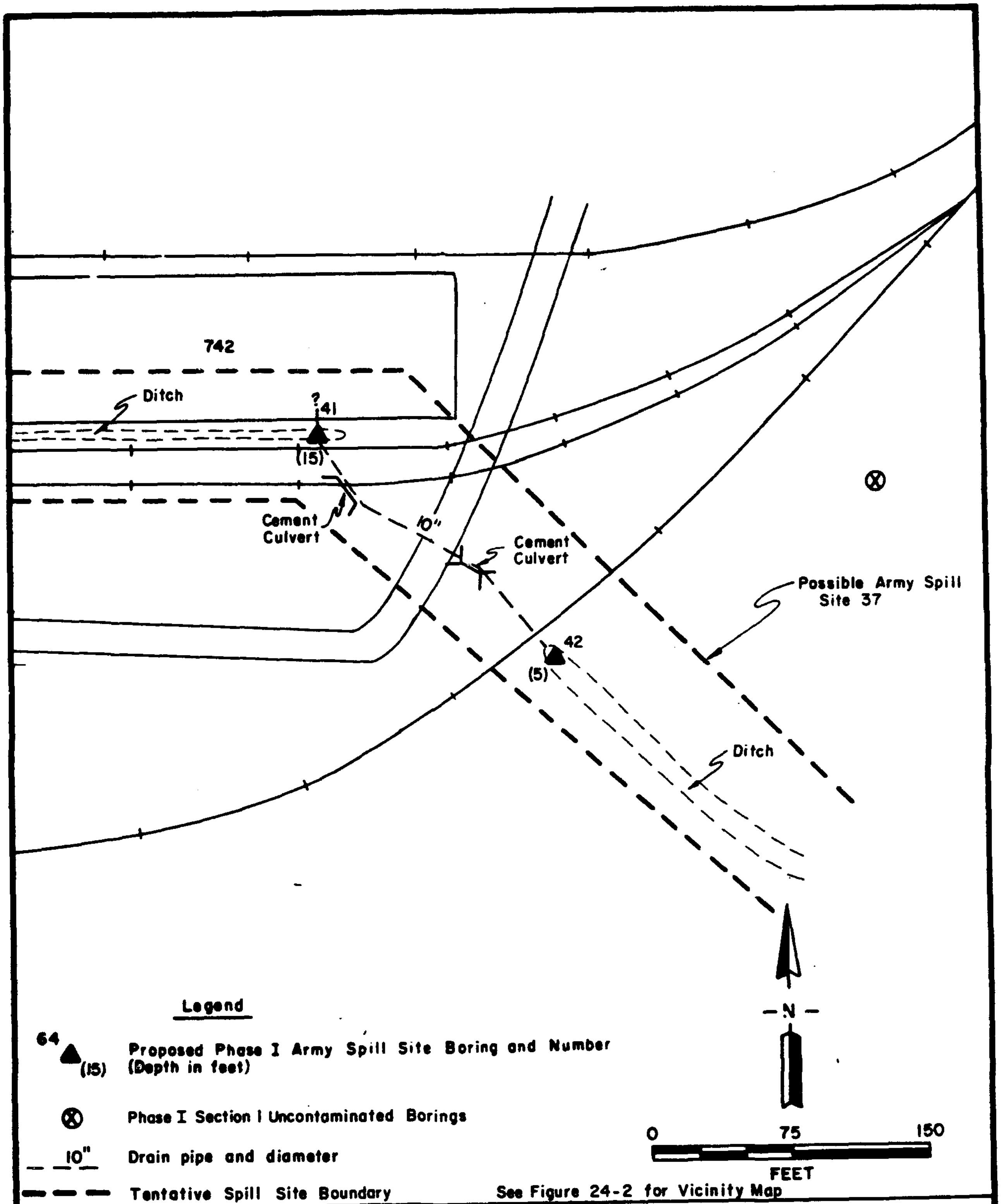
Preliminary literature searches indicate that Building 742 may also have been used for various aspects of mustard production; these uses will be explored more fully under the Task 24 structures survey (see the Task 24 Technical Plan, Volume II - Structures; Ebasco, 1987).

Two borings (41 and 42) are proposed for this spill area (Figure 24-26). The first boring (41) will be placed in the east-west ditch just south of Building 742, where the ditch discharges into the drainpipe that trends to the southeast, away from the building (see Figure 24-26); it will be drilled to the water table (anticipated to be at a depth of 15 ft in this area). Samples will be taken from the 0 to 1 ft, 4 to 5 ft, 9 to 10 ft, and 14 to 15 ft intervals. The second boring (42) will be located at the discharge point of the drainpipe into the ditch draining to the southeast, on the side of the railroad track opposite Building 742 (see Figure 24-26). This boring will be drilled to a total depth of 5 ft, and will be sampled at the 0 to 1 ft and 4 to 5 ft intervals.

As preliminary information indicates that aspects of mustard production may have occurred in the area, samples from the borings in this area will be analyzed for breakdown products of mustard using the thiodiglycol method. Additionally, the samples will be analyzed for the standard suite of Phase I analytes to detect other contaminants that may be present in this drainage. See Section 4.0 for a more detailed discussion of the analytical methods.

The planned borings, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	15	4	Phase I Analytes Thiodiglycol
1	5	2	Phase I Analytes Thiodiglycol



See Figure 24-2 for Vicinity Map

Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

Drafted: 12/1/86

FIGURE 24-26

Boring Location Map
Army Spill Site 37, Section I

Rocky Mountain Arsenal, Task 24

Prepared by: Ebasco Services Incorporated

Spill Site No. 38:

The salt storage pad was built in 1942 and 43 as a component of the chlorine plant. The pad was used to store salt which was used to create brine. From this brine, chlorine and caustic were manufactured (War Department, 1943).

The salt pad is a curbed pad composed of concrete slabs joined together by expansion joints (Donnelly, 1985j). It measures approximately 330 by 150 ft, and is sloped so that the north side is lower than the south side (Drawing No. 7164-378). The Army used the salt pad in its chlorine plant production operations during World War II from April 10, 1943, to August 15, 1945 (RMA, 1945p).

On January 24, 1947, Colorado Fuel & Iron (CF&I) entered into a lease for the chlorine plant facilities (Lease No. W-25-075-ENG-7920, 1947). CF&I ceased chlorine plant operations in early 1949. Julius Hyman Company expressed interest in leasing the chlorine plant from the Government, and entered into a lease for the chlorine plant facilities in December, 1949 (Silber, 1949) (Sup. Agreement, Lease No. W-25-075-ENG-7920, 1949). Shell/Hyman Chlorine Plant operations began on February 1, 1950, and ended on June 19, 1953 (Streich, undated).

On March 6, 1956, at the Army's request, Shell made the salt pad (Building 247) available to the Army (Johnson, 1956; Bejarano, 1956). In preparation for the GB brine project, the salt pad was lined with sheets of prefabricated asphalt in May 1956 (Donnelly, 1956; Gay, 1956; Staff Conference No. 14, 1956; Drawing No. RMA D-3-247-1).

The Army incorporated the salt pad into the chlorine plant decant system in June, 1956 (Cochran & Alker, 1958). At some time prior to the activation of the chlorine plant in September, 1956, several tank cars of GB scrubber brine were emptied onto the salt pad. Although no records were made of this incident, engineers assumed that the volume was several hundred-thousand gallons. The approximate composition of the brine by percentage weight:

	Step IV Effluent	Step V Effluent
NaCl	19.75%	22.14%
NaOH	0%	.33%
NaF	.94%	.64%
Total Phosphorous	.91%	.24%
$Na_2O_2POCH_3$	4.12%	1.08%
Na_3PO_4	0	0%
Na_2SO_4	Tr.	0%
Na_2CO_3	Tr.	Tr.
Isopropyl Alcohol	1.03%	Tr.
Water	73.25%	75.57%

(Cochran, Alker, 1958).

In order to increase the efficiency of the settling operations, the Army began using the salt pad as a settling basin. Beginning in January, 1957, calcium treated brine from the decant tanks was allowed to flow to the pad and settle. Liquid was either drawn-off into intermediate storage or filtered to remove precipitates. This settling operation continued through April (Cochran & Alker, 1958).

In February 1957, the Army began pumping the sludge from the clariflocculator onto the salt pad (Shell, 1955; U.S. Army, 1956; RMA, 1957). The approximate composition of the calcium treated brine by percentage weight:

NaCl	24.1%
NaOH	0.1%
NaF	0.1%
$Na_2CH_3PO_4$	0.1%
$CaCl_2$	0.4%
CaF_2	0.6%
$CaCH_3PO_3$	1.4%
Other	0.1%
Water	73.1%

The approximate composition of the clariflocculator sludge by percentage weight:

$NaCl$	18.4%
$NaOH$	0.1%
NaF	TR.
$Na_2CH_3PO_4$	0.1%
$CaCl_2$	0.2%
CaF_2	5.6%
$CaCH_3PO_3$	13.8%
$CaCO_3$	3.1%
Filter Aid	1.4%
Other	1.2%
Water	56.1%

(RMA, 1957).

The Army ceased chlorine plant operations in May, 1957 (Cochran & Alker, 1958).

In July, 1965, the Army informed Shell that solids (i.e. filter-cake) generated during aldrin production could no longer be dumped into Basin F. The Army suggested that this waste be drummed, and offered Shell the use of the salt pad as a drying facility. In a letter dated July 30, 1965, the Army informed Shell that effective October 30th, solid wastes must be placed on the salt pad (U.S. Army-RMA, Meeting Minutes, 1965; Burke, 1965; Williams, 1965). The salt pad was cleaned and made available for Shell's use; it is not known whether the asphalt lining was removed at this time.

Aldrin filter-cake, which consisted primarily of diadduct (an insoluble hydrocarbon) and aldrin (a Shell end-product), was formed in the aldrin reaction (Knaus, 1972; Shell, 1960; Kauffman, undated). Although the exact composition of the aldrin filter-cake was unknown, infrared analysis performed in 1959 and 1961 also revealed the presence of toluene and isodrin, an endrin process intermediate (Jones, 1959; Shell, 1961).

Between 1966 and 1969, Shell discharged filter-cake from the aldrin and dieldrin processes onto the salt pad. During this period, approximately 1.1 million pounds of aldrin process filter-cake and 36,000 lbs of dieldrin process filter-cake were discharged onto the salt pad. Shell may have also stored drummed waste on the pad as early as May, 1970 (Knaus, 1972; Hartman, 1970).

In 1970, the Army considered using the salt pad for the storage of solid wastes from mustard incineration, but this practice was not adopted (Hartman, 1970; Moss, 1970).

Shell began using the salt pad as a staging area for off-site drum shipments in the fall of 1971 (Knaus, 1971; Staaterman, 1972; Knaus, undated; Shell Response to Army Interrogatory 15, undated). In 1973, Shell excavated two trenches in Section 36 and placed the contents on the salt pad. The material in the trenches included drums containing solids and liquids, pipe, filter cartridges and process material. Whether the drums leaked is unknown. In 1974, the filter cake and the material from Section 36 was drummed and shipped off-site (Boyd, undated; Eck, 1982; Augenstein, undated).

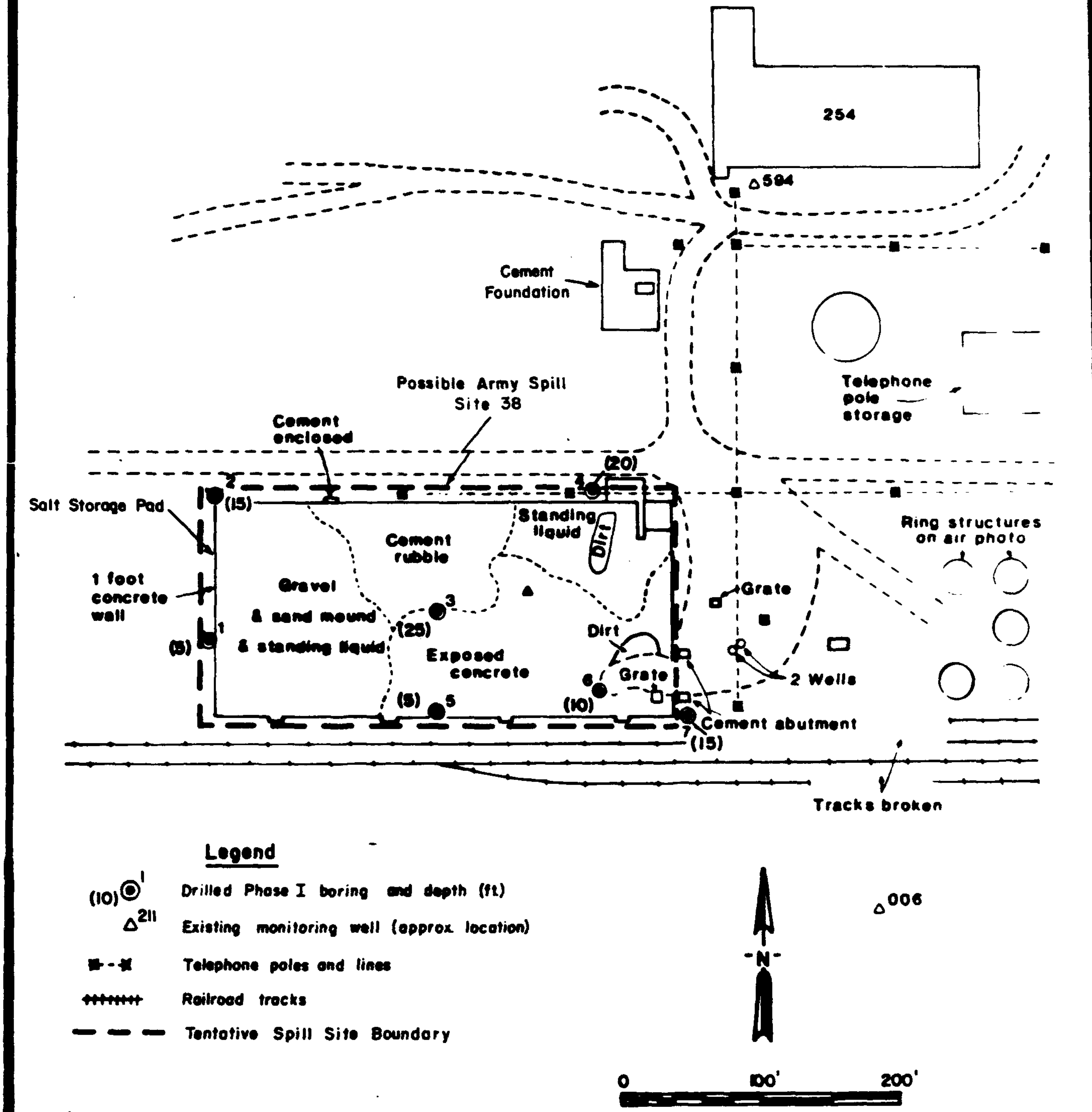
Shell continued to use the salt pad as a staging area for off-site drum shipments. After 1973, all drummed hazardous material that was to be sent off-site was stored on the salt pad. The salt pad was also used to store contaminated pipe and wooden pallets. Whether the drums leaked is unknown. Standing water in the salt pad was an ongoing concern. Pumps were installed in 1978 to divert this potentially contaminated water to the Denver Effluent Treatment Unit. Use of the salt pad for drum storage was suspended in February 1979 (Knaus, undated; Plummer, 1979; Boyd, undated; Plummer, 1978; Plummer, 1979; Swift, 1980; Augenstein, 1973; Memorandum of Discussion, 1976).

In the early 1980s, Shell used the salt pad as a storage facility for a variety of potentially contaminated material. In the spring of 1981, contaminated soil from the chemical sewer project was stored on the salt pad.

Solid waste created by Shell during the dismantling of production units in 1982 was drummed, labeled, and hauled to the salt pad for off-site disposal. As late as September 1985, potentially contaminated soil and concrete were being stored on the salt pad (Deposition transcript of E.W. Swift, Vol. III, p. 913; Deposition transcript of D. Eck, Vol. II, pp. 369-370; D.E. Eck, Report, Re: "Past Landfill Activity," undated but circa February 1982, REX001 0055-0075, 0071, S26002996564; Schneider, undated; Hahn, undated).

As originally constructed, the salt storage pad was part of the salt storage unit, which was designated as Building 247. The salt storage unit consisted of inactive and normal units. The inactive unit was the salt storage pad. The normal storage unit consisted of 6 wooden storage tanks each with a capacity of 50,000 gallons, and the salt unloading equipment (RMA, 1945q).

Soil contamination related to activities at this site is being investigated as Site 2-6 under Task 2 (Figure 24-27). Five Phase I borings have been drilled in and around the salt storage pad. Analytes detected within or above indicator levels include aldrin, dieldrin, atrazine, 1,2-dichloroethane p-chlorophenylmethyl sulfone, p-chlorophenylmethyl sulfoxide, copper, lead, and zinc. Four surface grab samples were collected from the mounded materials now present on the pad. Analytes detected within or above indicator levels include aldrin, dieldrin, chlordane, isodrin, dibromochloropropane, p-chlorophmylmethyl sulfone, p-chlorophenyl methyl sulfoxide, hexachlorocyclopentadiene, arsenic, cadmium, copper, lead, mercury, and zinc (Ebasco, 1987). Phase II borings and analyses are planned for this site as a part of activities under Task 2 (see "Source Report, Site 2-6, Salt Storage Pad," Ebasco, 1986f), for a description of the Phase II borings and analyses proposed for this area). No additional borings are planned for this spill under Task 24.



See Figure 24-2 for Vicinity Map

Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE 24-27

Boring Location Map
Army Spill Site 38, Section 2
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

Spill Site No. 39:

In the late 1940s, the Army spilled approximately 500 gal. of mercury catalyst used in the lewisite production process. The spill was initially reported as being north of Building 537, but apparently actually occurred in the lewisite reactor room in Building 514. A valve was accidently opened, and approximately 500 pounds (also referred to as 30,000 gallons and $25,000 worth) of mercury catalyst was released to the Building 513 decontamination reactors and then to the M-1 settling basins (Spill Site No. 2) (History of RMA, 1943; U.S. Supplemental Response to Shell Interrogatory, 1953; COE, 1943; Donnelly, 1985). Evidence of contamination within this building will be researched as a part of the structure surveys for the South Plants area (Task 24). Evidence for contamination at the M-1 settling basins will be investigated by five proposed borings (see spill site No. 2 of this report for locations and analyte data planned for these borings).

Spill Site No. 40:

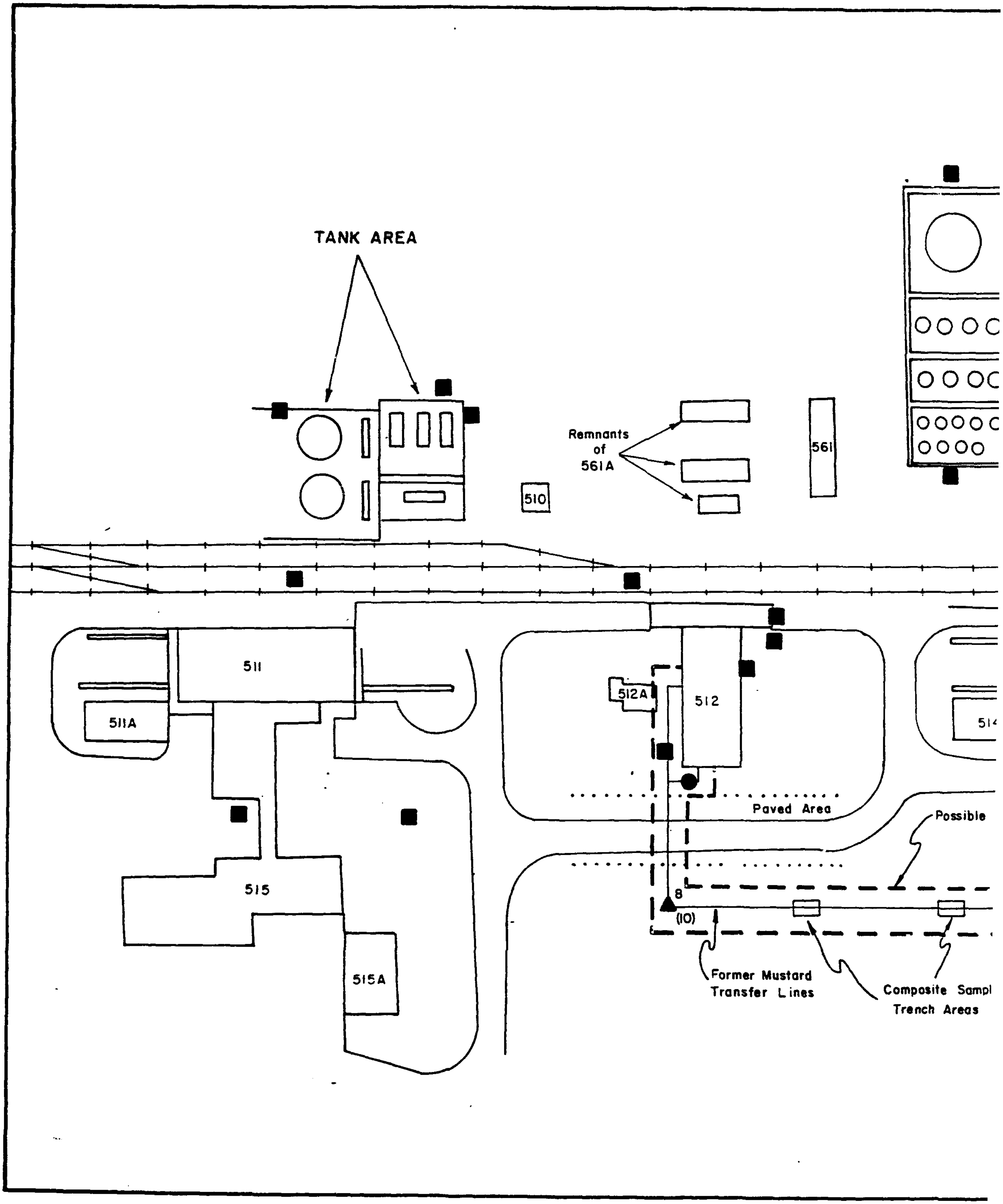
In 1945 and 1946, distilled mustard leaks may have occurred when the Army was transferring the materials from the finished supply tanks to the finished storage tanks (between Buildings 512 and 514). The transfer lines reportedly developed numerous leaks due to the corrosive action of the acid in the finished mustard product (RMA, 1946). The transfer lines have been removed.

One boring (8) is proposed for this spill area. This boring is located where the old transfer pipes made a right angle turn as they headed north into Building 512 from the east-west line west of Building 516 (see Figure 24-28); it is thought that there was the greatest likelihood for leaks at this right angle junction. The boring will be drilled to the water table (anticipated to be at a depth of 10 ft at this location). The boring will be sampled at the 0 to 1, and 4 to 5 and 9 to 10 ft, and subsequently (if necessary) at 5 ft intervals. Samples from the boring within this spill area will be analyzed for mustard breakdown products using the thiodiglycol method. In addition, as the nature of the reported leaks is not known, samples from the boring will be analyzed for the standard suite of Phase I analytes. See Section 4.0 for a more detailed discussion of analytical methods.

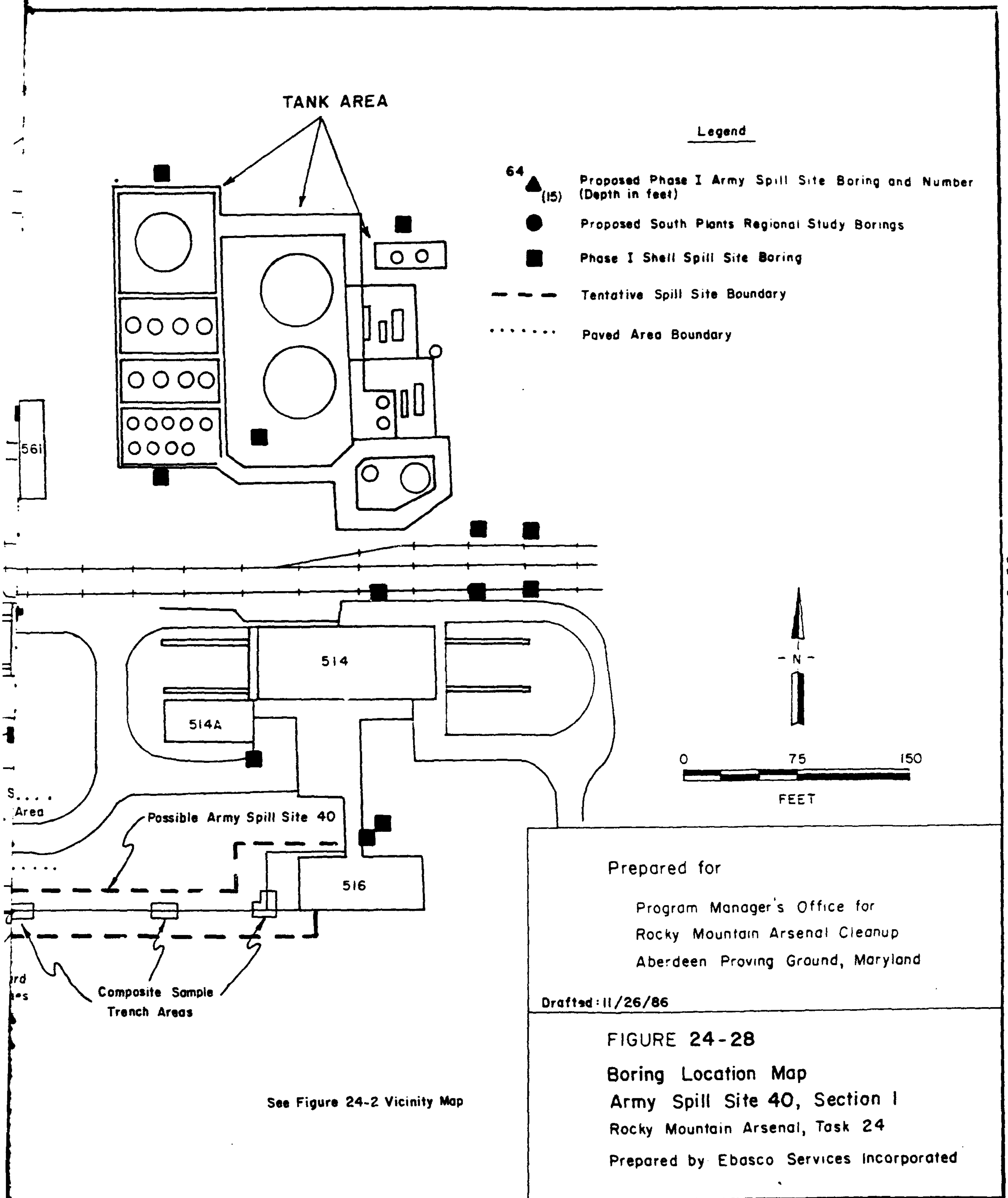
In addition to the samples from the boring, one composite sample will be taken from each of three equally spaced trenches 20 ft in length and 0.5 ft in depth located along the east-west line from Building 516 (see Figure 24-28). Each sample will consist of soil taken from the bottom of each trench along its entire length. No trenching will be done under the north-south line, as the area under this line is paved. The three composite samples will be analyzed for breakdown products of Army agents (see Section 4.0).

The planned boring and trenching, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	10	3	Phase I Analytes Thiodiglycol
3 trenches	0.5	3 composite	Thiodiglycol



TANK AREA
Remnants of 561A
561
510
511
511A
512A
512
514
515
515A
Paved Area
Possible
8
(10)
Former Mustard Transfer Lines
Composite Sampl
Trench Areas



Prepared for

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

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FIGURE 24-28
Boring Location Map
Army Spill Site 40, Section I
Rocky Mountain Arsenal, Task 24
Prepared by Ebasco Services Incorporated

Spill Site No. 41:

Between 1943 and 1945, spent acid reportedly leaked from holes that developed in the line from the spent acid tank to the sewer. The leaks caused the ground to swell, making nearby buildings structurally unsafe, and requiring the construction (in 1946) of a new acid mist and storage building in the chlorine plant. Evidence of the structural damage from the ground swelling is visible on the northern wall of Building 243 (see Figure 24-29) (Donnelly, 1986).

Several borings were located in this area as part of the Phase I study for Site 2-8 under Task 2 (see Figures 24-2 and 24-29). Information on the analytical results from samples taken from these borings will be available in the Site 2-8 Source Report.

One boring (21) is planned for this spill area; it will be drilled to the water table (anticipated to be at 20 ft in this area). The boring will be located north of Building 243, within the perimeter of the former spent acid tank. Samples will be taken at the 0 to 1, 4 to 5, 9 to 10, 14 to 15, and 19 to 20 ft intervals. The samples will be analyzed for the standard suite of Phase I analytes (see Section 4.0).

The planned boring, depth, number of samples, and analytes for this area are summarized as follows:

Number of Borings	Total Depth (ft)	Number of Samples	Analytes
1	20	5	Phase I Analytes

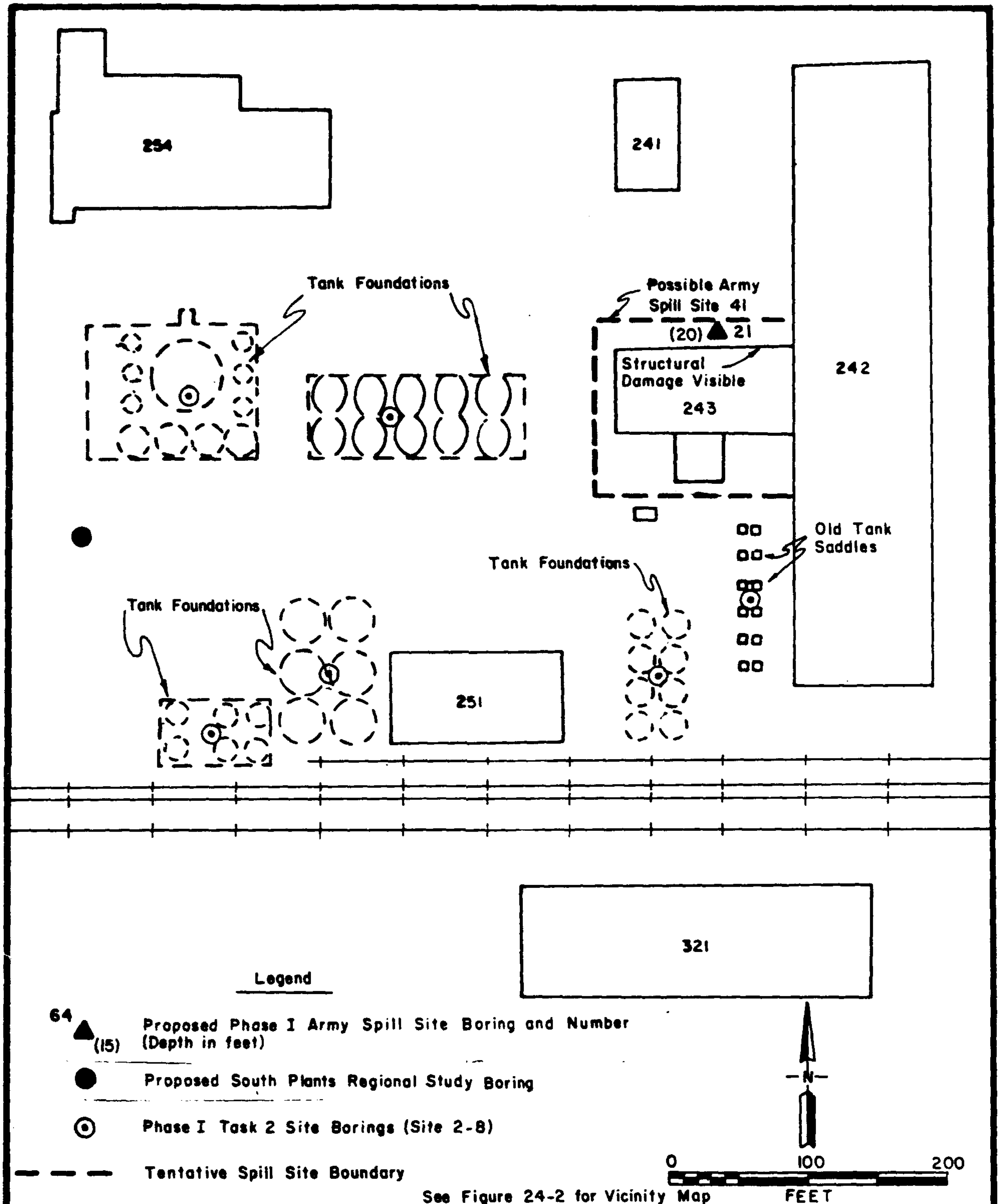

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FIGURE 24-29
Boring Location Map
Army Spill Site 41, Section I
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

Table 24-2. Summary of the Task 24 Army Spill Sites Boring and Sampling Program

Army Spill Site No.	Description	Number of Borings	No. of Samples/ Types of Analytes
1	Toluene spill north of Building 511.	None	None
2	M-1 (lewisite) disposal facility and basins.	5	24-Phase I Analytes 24-Organoarsenic Compounds 24-Organomercury Compounds 24-Thiodiglycol
3	Arsenic trichloride, mercury and mercuric chloride spills; contained within buildings.	None	None
4	Mercury spill behind Building 512 (not verified).	None	None
5	Lewisite production area; mercuric chloride, arsenic oxide, acetylene, and lewisite were allegedly lost through tank/ pipe leaks.	3	6-Thiodiglycol 6-Organoarsenic Compounds 6-Organomercury Compounds
6	Lewisite spills, Buildings 536 and 537 (not verified).	3	2-Phase I Analytes 6-Organoarsenic Compounds 6-Thiodiglycol
7	Mustard leaks from one-ton containers stored on an unpaved area near Buildings 536 and 537.	2	10-Inorganic Arsenic** 10-Inorganic Mercury** 10-Thiodiglycol
8	Possible mustard breakdown products encountered by Shell during installation of a sump tank in an area between Buildings 514 and 529.	1	5-Thiodiglycol 5-Phase I Analytes
9	Diesel fuel spill due to tank overfilling in an area south of Building 732.	Preliminary Soil Gas Screening (32 points*)	32-Diesel Fuel Signatures*

Table 24-2. Summary of the Task 24 Army Spill Sites Boring and Sampling Program (Continued)

Page 2 of 5 pages

Army Spill Site No.	Description	Number of Borings	No. of Samples/ Types of Analytes
10	No reported spills of the pesticides and herbicides stored in Building 753 by Shell.	2	4-Phase I Analytes
11	Spill of unknown quantity of chlorobenzene near Building 471 (location not verified).	None	None
12	Holding pits for lime sludge from the acetylene generators; outside of Building 522.	2	10-Phase I Analytes
13	Arsenic trioxide dust leaks from the arsenic trioxide storage silos 523C, 523D, 523E, 523F, 523G, and associated conveyance and loading areas.	4	2-Phase I Analytes 11-Organoarsenic Compounds
14	Mustard decontamination pits in Buildings 417 and 427.	5	10-Phase I Analytes 21-Thiodiglycol
15	Decontamination pit near the SE corner of Building 514; received contaminated mustard washwater.	1	5-Phase I Analytes 5-Thiodiglycol
16	Unlined surface ditch east of Building 314; received wash and decon water from the laundry and clothing treatment facilities.	1	4-Phase I Analytes 4-Organoarsenic Compounds 4-Thiodiglycol
17	Laboratory sink wastewater disposal; Building 313 and open ditch east of building.	2	8-Phase I Analytes 8-Organoarsenic Compounds 8-Organomercury Compounds 8-Thiodiglycol

Table 24-2. Summary of the Task 24 Army Spill Sites Boring and Sampling Program (Continued)

Army Spill Site No.	Description	Number of Borings	No. of Samples/ Types of Analytes
18	Petroleum products, paints thinners, and solvents spilled in and around maintenance shops (Buildings 533 and 534).	Preliminary Soil Gas Screening (62 Points*) 1 boring 1 grab	62-Petroleum Product Signatures* 18-Chlorinated Hydrocarbon Signatures* 5-Phase I Analytes
19	Spills of organochlorine compounds, degreasing solvents, paint strippers, rust removers, paints, thinners, and other solvents in Building 751.	2	9-Phase I Analytes
20	Leak of unknown liquid from caustic tank east of Building 536 into drainage ditch west of the tank.	2	3-Phase I Analytes 6-Thiodiglycol
21	No site description in Shell letter (May 1985).	None	None
22	1200-lb mustard spill to drains, Building 537.	None	None
23	No site description in Shell letter (May 1985).	None	None
24	Mercury spills during Orsate gas sampling, Building 534.	None	None
25	"Phossy water" wastes from white phosphorus cup filling operations discharged to ditch north of Building 541.	3	9-Phase I Analytes 9-Organoarsenic Compounds 9-Thiodiglycol
26	Phosgene gas leaks during bomb-filling operations in Buildings 331 and 332.	None	None
27	Several spills of lead azide to drains in Buildings 362 and 365.	None	None

Table 24-2. Summary of the Task 24 Army Spill Sites Boring and Sampling Program (Continued)

Army Spill Site No.	Description	Number of Borings	No. of Samples/ Types of Analytes
28	Several spills of red phosphorus to drains in Buildings 362 and 365.	None	None
29	Arsenic sludge discharged to "settling basin;" there is a basin in this area, now covered by the expansion of Building 523 (use for receiving arsenic sludges not verified).	1	3-Phase I Analytes
30	Release of 3700 lbs of chlorine in gaseous form at track scale adjacent to Building 252.	None	None
31	Leaks from tank cars and car valves along railroad tracks and sidings.	None	None; see South Plants Regional Study
32	Water used to flush out hydrazine drums on pad in hydrazine facility; discharged to waste pit.	None	None; sampling was done at this site under Task 11
33	Spill of mercury in instrument laboratory, Building 543; cleaned up.	None	None
34	Explosion at mouth of charging hopper for acetylene generator unit Building 543.	None	None
35	Release of GB within Building 1501; neutralized with caustic; mixture disposed into 55-gal drums.	None	None
36	Spill of unknown quantity of hydrofluoric acid in Building 1501.	None	None

Table 24-2. Summary of the Task 24 Army Spill Sites Boring and Sampling Program (Continued)

Army Spill Site No.	Description	Number of Borings	No. of Samples/ Types of Analytes
37	Spill of concentrated mixed acid (nitric and sulfuric) to head of ditch SE of Building 742 (neutralized with sodium hydroxide).	2	6-Phase I Analytes 6-Thiodiglycol
38	Salt storage pad (Site 2-6); storage of inactive salts and GB brines.	None	None; additional analyses will be done under Phase II of Task 2, Site 2-6
39	Spill of about 500 gallons of mercury catalyst within Building 537.	None	None
40	Distilled mustard leaks during transfer of materials between tanks; between Buildings 512 and 514.	1 boring 3 trenches	3-Phase I Analytes 3-Thiodiglycol 3-Composites; Thiodiglycol
41	Spent acid leaks near the old chlorine plant; exact location unknown.	1	5-Phase I Analytes
	TOTALS	44 Borings 1 Grab 3 Trenches 94 Soil Gas Points*	112-Phase I Analytes 68-Organoarsenic Compounds 38-Organomercury Compounds 101-Thiodiglycol 10-Inorganic Arsenic** 10-Inorganic Mercury**

* Soil gas samples will undergo separate analyses and are not included in the total number of samples that will be submitted to project laboratories.

**Inorganic Arsenic and Inorganic Mercury listed as separate analyses indicate that standard Phase I methodologies will be utilized, but that these substances are the only Phase I analytes for which analyses will be run.

3.2.2 Sampling Approach for Soils

All borings will be drilled and sampled using a continuous core augering technique except as noted below. Five foot cores within clear polybutyrate tubes will be obtained. Although the sampling intervals were predetermined during Tasks 1 and 2, this method of obtaining the soil core in clear polybutyrate tubes will allow the field geologist to see and select any stained portions of the core as samples. Such samples will also then be sent to the laboratory for chemical analysis, in addition to those from the predetermined intervals. Field measurements of volatile organics will be made during coring using a flame ionization organic vapor analyzer (OVA) or a photoionization organic vapor detector (HNu) for health and safety monitoring purposes.

Borings in areas of standing water, soggy soil conditions, or difficult access will be sampled differently. Thorough field reconnaissance of these sites will precede boring activities, and the method of boring will be chosen at that time. Alternative methods include:

- o Hollow-stem spoon driven by a 140 lb weight attached to a motorized cathead system.
- o Hand-held sediment corer. This method will be used in swampy or unstable soil areas.
- o Hand-trenching. This method will be used in areas where shallow composited samples are required.

Detailed descriptions of the coring and sample handling procedures can be found in the RMA Procedures Manual (Ebasco, 1985b).

As soon as the samples are obtained for chemical analysis, the remaining cores will be resealed and stored. This procedure will allow the cores to be available if additional core examination or analysis is required; however, it is likely that sample holding times will have been exceeded and stored cores will generally not be analyzed.

3.2.3 Evaluation of Phase I Soil Boring Data

The primary objectives of the Phase I soil sampling program are to assess whether soil contamination exists in the unsaturated zone and what types of contaminants are present. After the soils and geologic data are collected, they will be processed through the QA/QC and data management routines, as described in Sections 5.0 and 6.0 of this document, and then evaluated. The chemical data will be integrated with the soils and geologic data as soon as they become available. With these data, the types and concentrations of contaminants present, estimates of the lateral and vertical extent of the contaminants, and contaminant boundaries will be estimated.

3.3 SUPPORT FACILITIES

During the mobilization meetings at RMA held the week of October 29 to November 2, 1984, the need for RMA support facilities was identified, and initial discussions were held with RMA Installation Services personnel regarding the location and establishment of such facilities. The support needs discussed included warehouse space, office space, utilities (electric power and portable water and sanitary facilities) at the warehouse and office, and RMA's selection of a location for decontamination activities.

During meetings subsequent to the initial mobilization meetings and involving Ebasco, Environmental Science and Engineering, Inc. (ESE), and RMA Facilities Engineering personnel, locations of the command center and support facilities were agreed upon. They are located along December 7th Avenue approximately 2,500 ft east of its intersection with "D" Street and north of Building 732 (Figure 24-2). RMA Facilities Engineering, with the support of Stearns Catalytic, has provided hookups for electricity, potable water, and sanitary sewer facilities for the Ebasco office trailer and ESE support facilities, as well as electricity and water supplies for the existing steam cleaning area. Personnel decontamination activities and facilities are described further in the Health and Safety Plan located in Section V of the Rocky Mountain Arsenal Procedures Manual to the Technical Plan (Ebasco, 1985b).

Heated and lighted warehouse space has been provided by RMA for the use of both Ebasco and ESE. The eastern half of Building 728 (see Figure 24-5) has been made available for this purpose. This building has been divided in half by a firewall and RMA has further subdivided the eastern half into three approximately equal areas by chain link fences. The central area is being used by RMA for miscellaneous equipment storage. The two outer areas are used by Ebasco and ESE. Each of these outer areas can be reached through separate 12 ft doors from separate loading docks on the northern side of the building.

In addition to Building 728, RMA has provided warehouse space in Building 733C for storage of some sample cores obtained during this task. Potentially hazardous solid materials such as used protective clothing are placed in drums, which are subsequently placed on pallets in Building 732.

3.4 SUPPORT ACTIVITIES

3.4.1 Topographic Surveys

Each excavation borehole will be surveyed to establish its elevation and map coordinates with respect to the Colorado State Plane Coordinate System. All elevations and coordinates will be surveyed to the nearest 0.1 ft (3 centimeters) vertically and 3 ft (1 meter) horizontally, consistent with U.S. Army Toxic and Hazardous Materiels Agency (USATHAMA)/PMO requirements.

3.4.2 Decontamination of Equipment and Materials

Procedures for the decontamination of equipment and materials will meet health and safety requirements and quality control requirements. Equipment such as sampling tools and boring equipment will be maintained and decontaminated to preclude cross-contamination between samples and from one site to another. Some decontamination activities will take place at the sampling locations.

These activities will utilize the mobile decontamination facilities discussed in the Health and Safety Plan of the Rocky Mountain Arsenal Procedures Manual (Ebasco, 1985b). Major decontamination of equipment, particularly the larger pieces of equipment, will take place at the regional steam cleaning areas.

Drilling and sampling equipment likely to have come into contact with potentially agent-contaminated soils will not be removed from RMA until results of chemical analyses indicate no agent is present or the equipment is certified as agent-free by the Army.

3.4.3 Waste Disposal

At the direction of PMO, all contaminated wastes, including liquids, soils, and other solid wastes, will be containerized and stored at a designated central storage area that meets substantive RCRA requirements (EPA, 1985b). The following are handled as contaminated wastes, unless they are sampled, analyzed, and determined to be free of any contamination:

- All soils not used for analysis purposes if they are from areas previously designated as contaminated,
- Disposable sampling gear,
- Liquids generated at the steam cleaning pit; and
- Purge water from well development and sampling.

The solid materials will be placed in drums on pallets and removed to controlled disposal sites (Building 732). Decontamination wastewater will be placed in a series of 1,500 to 2,500 gal. tanks. When the tanks are full, the water in the tanks will be analyzed. If it is free of contaminants, it will be disposed in the sanitary sewer. If it is contaminated, it will be disposed in the South Plants laboratory waste treatment facility.

Uncontaminated wastes will be disposed in the sanitary sewer system or in appropriate trash disposal facilities. Portable or chemical toilet wastes will be disposed according to normal protocols for these wastes.

3.4.4 Water Used in Geotechnical Program

Two types of water will be used for the soil sampling program. For steam cleaning, decontamination, and other related activities, the water used will be chlorinated city water, which is obtained from the RMA fire department's water supply. Some sites may require prior preparation, such as removal of concrete or asphalt above the soil boring area. The bits or blades of tools used for cutting these hard materials often require cooling with water. In these areas, where water might contact the underlying soil, unchlorinated water from an off-site uncontaminated source will be used.

3.5 GEOPHYSICAL PROGRAM

3.5.1 Purpose

Geophysical surveys will be conducted for safety purposes as appropriate to ensure, to the extent possible, that boring locations are clear of buried metallic objects and underground utilities. In general, geophysical surveys will be conducted in areas where historical information or visual observations indicate that buried metallic objects and underground utilities are likely.

3.5.2 Techniques

Potentially applicable geophysical techniques have been tested for their effectiveness at RMA. These tests and their results are described in the RMA Procedures Manual (Ebasco, 1985b, Volume I, Section II).

Two geophysical methods will be used to locate buried metallic objects. They are magnetics, using a magnetic field gradiometer; and resistivity, using a pulse induction metal detector. The same methods will be used to detect certain kinds of buried utilities. If the objects are within approximately 5 ft of the surface and are composed of ferrous (magnetically susceptible) material or electrically conductive material (e.g., iron, steel, aluminum, copper), they may be detectable. However, neither method will be useful in detecting and locating nonferrous, nonmetallic objects (for example, some underground piping is made of vitrified clay). Objects made of other nonconductive materials are also often not detectable.

3.5.3 Geophysical Surveys

Magnetometer surveys for buried metal objects will be conducted at all spill sites where drilling is proposed in areas served by utilities. The purpose of the surveys is to identify areas where drilling may encounter buried pipelines or similar features. Currently, UXOs are not anticipated at any of the spill sites; however, the detailed literature search may reveal areas that may contain UXOs. If such areas are discovered, geophysical surveys will also be conducted there to aid in assuring that UXOs will not be encountered during drilling.

All surveys will be conducted well in advance of drilling operations to allow for an assessment of the geophysical results and relocation of the boring locations, if required.

4.0 CHEMICAL ANALYSIS PROGRAM

The chemical analysis program was designed to be consistent with the sampling program for Task 24. Analytical methods for this task are described in more detail below. Most of the referenced analytical methods in this Technical Plan are those specified for use in Tasks 1 and 2. These analytical methods were divided between the four contractor laboratories for method development prior to the initiation of Task 2 field activities. Once a method was developed, it was distributed to all contractor laboratories for certification. Certification of all methods has been, or will be, completed prior to analysis of any Task 24 samples. At present, methods for analyzing several Army agent degradation products are being developed. When these methods are certified, the Technical Plan will be modified to include these analytical methods.

All samples collected will be screened for target and nontarget analytes. The analytical methods used, detection levels, high range concentrations, sample holding times, certification levels, and reference methods for all analytes are identified in Table 24-3.

Only soil and solid matrices (e.g., soil borings and sediments) will be sampled during Task 24. Soil and solid matrix samples will be assayed semi-quantitatively by gas chromatography/mass spectroscopy (GC/MS) for volatile and semivolatile organic target analytes. An attempt will be made to identify other major unknown peaks present in the GC/MS total ion current profiles. Nontarget analytes that may be detected include discarded commercial chemical products, off-specifications species, container residues, and spill residues (40 CFR 261.33); and analytes listed in Appendix VIII, 40 CFR 261 as being detectable by the GC/MS analytical methodology cited in this document. Collected samples will also be assayed quantitatively by graphite furnace atomic absorption spectroscopy for arsenic, by cold vapor atomic absorption spectroscopy for mercury, and by inductively coupled argon plasma (ICP) spectroscopy for other target metals.

Table 24-3. Analytical Methods/Solid Matrix (Soil, Solids, Sediment) for Task 24 (Page 1 of 4).

Analysis/Matrix/Analytes	Detection Limit (1)	High Range Concentration	Hold Time (2)	Level of Certification	Reference Methods (3)
Volatile Organics/Solids			7 days for	Semi-	USATHAMA N9
1,1-Dichloroethane	0.5 ug/g	25 ug/g	the solid	Quantitative (4)	for UBTL and
Dichloromethane	0.5 ug/g	25 ug/g	and 30 days		K9 for CAL
1,2-Dichloroethane	0.5 ug/g	25 ug/g	for the		
1,1,1-Trichloroethane	0.5 ug/g	25 ug/g	extract		
1,1,2-Trichloroethane	0.5 ug/g	25 ug/g			
Carbon tetrachloride	0.5 ug/g	25 ug/g			
Chloroform	0.5 ug/g	25 ug/g			
Tetrachloroethylene	0.5 ug/g	25 ug/g			
Trichloroethylene	0.5 ug/g	25 ug/g			
Trans-1,2-Dichloroethylene	0.5 ug/g	25 ug/g			
Benzene	0.5 ug/g	25 ug/g			
Toluene	0.5 ug/g	25 ug/g			
Xylene (3 isomers)	0.5 ug/g	25 ug/g			
Ethylbenzene	0.5 ug/g	25 ug/g			
Chlorobenzene	0.5 ug/g	25 ug/g			
Methylisobutyl ketone	0.5 ug/g	25 ug/g			
Dimethyldisulfide	0.5 ug/g	25 ug/g			
Bicycloheptadiene	0.5 ug/g	25 ug/g			
Dicyclopentadiene	0.5 ug/g	25 ug/g			
Semivolatile Organics/Solids			7 days for	Semi-	USATHAMA L9
Aldrin	0.5 ug/g	100 ug/g	the solid &	Quantitative (4)	for UBTL,
Endrin	0.5 ug/g	100 ug/g	30 days for		X9 for CAL and
Dieldrin	0.5 ug/g	100 ug/g	the extract		X9-A for HEA
Isodrin	0.5 ug/g	100 ug/g			
p,p'-DDT	0.5 ug/g	50 ug/g			
p,p'-DDE	0.5 ug/g	100 ug/g			
Chlorophenylmethyl sulfide	0.5 ug/g	100 ug/g			
Chlorophenylmethyl sulfoxide	0.5 ug/g	50 ug/g			
Chlorophenylmethyl sulfone	0.5 ug/g	100 ug/g			

Task 24
4762A/1116A
Rev. 1/22/87

Table 24-3. Analytical Methods/Solid Matrix (Soil, Solids, Sediment) for Task 24 (Page 2 of 4).

Analysis/Matrix/Analytes	Detection Limit (1)	High Range Concentration	Hold Time (2)	Level of Certification	Reference Methods (3)
Hexachlorocyclopentadiene	0.5 ug/g	100 ug/g			
Oxathiane	0.5 ug/g	100 ug/g			
Dithiane	0.5 ug/g	100 ug/g			
Malathion	0.5 ug/g	100 ug/g			
Parathion	0.5 ug/g	100 ug/g			
Chlordane	0.5 ug/g	100 ug/g			
Azodrin	0.5 ug/g	100 ug/g			
Vapona	0.5 ug/g	100 ug/g			
Supona	0.5 ug/g	100 ug/g			
DIMP	0.5 ug/g	50 ug/g			
Atrazine	0.5 ug/g	100 ug/g			
1,2-Dibromo-3-chloropropane	0.5 ug/g	100 ug/g			USATHAMA S9 for UBTL and Z9 for CAL
ICP Metal Screen/Solids			6 mos	Quantitative (5)	USATHAMA P9 for UBTL and A9 for CAL
Cadmium	0.5 ug/g	500 ug/g			
Chromium	5 ug/g	500 ug/g			
Copper	5 ug/g	500 ug/g			
Lead	5 ug/g	500 ug/g			
Zinc	5 ug/g	500 ug/g			

Table 24-3. Analytical Methods/Solid Matrix (Soil, Solids, Sediment) for Task 24 (Page 3 of 4).

Analysis/Matrix/Analytes	Detection Limit (1)	High Range Concentration	Hold Time (2)	Level of Certification	Reference Methods (3)
Arsenic/Solids	1 ug/g	10 ug/g	6 mos	Quantitative (5)	USATHAMA B9 for UBTL and G9 for CAL
Mercury/Solids	0.1 ug/g	1 ug/g	28 days	Quantitative (5)	USATHAMA Y9 for UBTL and J9 for CAL
Thiodigylcol/solids	-	-	-	-	Method under development by ESE
Organics Screen/Air-Charcoal	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH
Organics Screen/Air-Tenax	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH

Table 24-3. Analytical Methods/Solid Matrix (Soil, Solids, Sediment) for Task 24 (Page 4 of 4).

NOTES:

(1) Actual detection limits for the certified methods are identified in Section IV of the Rocky Mountain Arsenal Procedures Manual, Section 12.4 and Appendix B. Detection limits for uncertified methods and for methods to be certified are desired detection limits.

(2) Sample holding times are identified in Section IV of the Rocky Mountain Arsenal Procedures Manual, Sections 8.4 and 10.3.

(3) Analytical methods are described in Section IV of the Rocky Mountain Arsenal Procedures Manual, Section 10.0 and Appendix B.

(4) Semi-Quantiative: See Section IV of the Rocky Mountain Arsenal Procedures Manual, Section 11.2.2.1.

(5) Quantitative: See Section IV of the Rocky Mountain Arsenal Procedures Manual, Section 11.2.2.2.

Reference:

Ebasco Services Inc. 1985. Section IV, Project Quality Assurance Plan, Rocky Mountain Arsenal Procedures Manual to the Technical Plan, August 1985, Contract NO. DAAK11-84-D-0017, Final Draft.

Analytical methods for monitoring worker exposure to potential contaminants (e.g., the method for detecting volatile organics in air) will not be USATHAMA/PMO Certified. Data from these samples will be used to assess the potential for exposure of workers to such substances and to define appropriate levels of personal protection for onsite workers.

Sample shipping and holding temperatures are described in the QA/QC Plan of the RMA Procedures Manual (Ebasco, 1985b).

4.1 SAMPLE MATRICES

All soil, sludge, sediment, and solid matrices are considered as soils for analytical purposes. All soil and solid analytical methods have been or will be USATHAMA/PMO Certified on a representative soil prior to sample collection. This representative soil is a background soil collected from the RMA area. Data for soil and solid matrices are initially reported on a dry weight basis and may be converted to a wet weight basis as required by the PMO.

A summary of laboratory analyses indicating preservation guidelines, analytical methods required, levels of certification, total analytical requirements, and weekly laboratory rates of analysis is also given in the QA/QC Plan of the RMA Procedures Manual (Ebasco, 1985b).

4.2 ANALYTICAL METHODS FOR SOLID MATRICES

Analyses prescribed for a given site or set of samples are selected based on type of activities known to have been conducted at each site. For samples collected from segments where no information exists, the entire suite of analyses will be conducted.

This section briefly describes the analytical methods that will be used for samples collected during Task 24 activities. The specific protocol for each method may be reviewed in Section IV, Project Quality Assurance Plan, RMA Procedures Manual (Ebasco 1985b).

4.2.1 Volatile Organics

The volatile organics (VO) method in solids was based on EPA Method 8240 (EPA SW-846). This method was USATHAMA/PMO Certified for soils and solids at the semi-quantitative level. (See Section IV of the RMA Procedures Manual for method). Analysis for these compounds will be restricted to deep soils (those from intervals deeper than 0-1 ft); due to the volatility of these compounds, it is unlikely that they will be present in detectable quantities in the shallow soil intervals.

In this method, a 10 gram (g) portion of the sample will be obtained with minimum of handling and placed into 10 milliliter (ml) methanol in a volatile organic acid (VOA) septum vial, spiked with the surrogates methylene chloride-d_2, benzene-d_6, and ethylbenzene-d_{10}, capped with a Teflon lined lid and shaken for four hours. A 20 microgram (ug) aliquot of the methanol extract will be removed, spiked with 200 ug of 1,2-dibromo-ethane-d_4 as an internal standard and injected into 5.0 ml of organics-free water contained in a syringe. The contents of the syringe will then be injected into a purging device, purged, and analyzed on a packed column (1 percent SP-1000 on Carbopack B) by GC/MS.

4.2.2 Semivolatile Organics

The analytical technique for semivolatile organics (SVO) was based on EPA Method 8270 in solids (EPA SW-846) and was USATHAMA/PMO Certified in soils and solids at the semi-quantitative level. (See Section IV of the RMA Procedures manual for method).

Using this method, a 15 g portion of the sample will be obtained with a minimum of handling and spiked with the surrogates 1,3-dichloro-benzene-d_4, diethylphthalate-d_4, 2-chlorophenol-d_4, and di-n-octylphthalate-d_4. The sample will be mixed with anhydrous sodium sulfate (30 g or more, depending on sample moisture content); it will then be soxhelet extracted for eight hours with 300 ml methylene chloride. The extract will be reduced to a final volume of 10 ml in a Kuderna-Danish (K-D) apparatus. An aliquot of this concentrate will be spiked with phenanthrene-d_{10} as an internal standard and analyzed on a fused silica capillary column by GC/MS. Samples will be assayed for target analytes at the detection limits shown in Table 4.3-1.

4.2.3 Metals

The inductively coupled argon plasma spectroscopy (ICP) method, based on USATHAMA Method 7S, is USATHAMA/PMO Certified at the quantitative level (See Section IV of the RMA Procedures Manual for method).

In this procedure, a 1.0 g portion of sample will be digested in a watch glass covered Griffin beaker with 3.0 ml of concentrated nitric acid. Contents of the beaker will be heated to near dryness and repeated portions of concentrated nitric acid added until the sample is completely digested. The digestion process is finished with 2.0 ml of 1:1 nitric acid and 2 ml of 1:1 hydrochloric acid. The sample digest will be filtered, the beaker and watch glass rinsed with deionized water, and rinsate passed through the filter. The digestate is brought to a final volume of 50 ml and assayed by ICP. Samples will be assayed for target metals at detection limits identified in Table 24-3.

4.2.4 Arsenic

The arsenic method in soils and solids was developed from EPA Method 7060 (EPA-SW-846). Using this method, a 1.0 g sample will be digested with hydrogen peroxide and concentrated nitric acid. The digest will be filtered and assayed by graphite furnace atomic absorption spectrometry. The detection limit for arsenic is 1.0 micrograms per gram (ug/g). This method was USATHAMA/PMO Certified at the quantitative level (See Section IV of the RMA Procedures Manual for method).

4.2.5 Mercury

The mercury method, developed from EPA Method 245.5 (EPA 600/4-82-057), was USATHAMA/PMO Certified at the quantitative level (See Section IV of the RMA Procedures Manual for method). In this method a 1.0 g sample portion will be digested with aqua regia followed by treatment with potassium permanganate.

Excess permanganate will be reduced with hydroxylamine sulfate. Mercury will be reduced with stannous chloride and assayed by cold vapor AA. The target detection limit for mercury is 0.1 ug/g.

4.2.6 Thiodiglycol

The analytical method for thiodiglycol is being developed by ESE and will be certified prior to the start of the Task 24 field investigation program. The method will be quantitative.

4.2.7 Isopropylmethyl Phosphonate

The analytical method for isopropylmethyl phosphonate is being developed by MRI and will be certified prior to the start of Task 24 field sampling activities. The method will be quantitative.

4.2.8 Organoarsenic

The analytical method for organoarsenic compounds is being developed by CAL and will be certified prior to the start of Task 24 field sampling activities. The method will be quantitative.

4.2.9 Organomercury

The analytical method for organomercury compounds is being developed by DataChem and will be certified prior to the start of Task 24 field sampling activities. The method will be quantitative.

4.2.10 Volatile Organic Compounds in Air Using Activated Charcoal and Tenax

This method was designed by DataChem, Inc. for the National Institute of Occupational Safety and Health (NIOSH). It will be used as a screening tool to assess potential exposure of onsite workers to volatile organic contaminants in air during the Task 24 program.

A small pump will be utilized to draw air into a tube containing Tenax and activated charcoal. The tube will then be sent to the laboratory for analysis. The charcoal is desorbed with methylene chloride, and Tenax with isooctane. Extracts will be analyzed by packed column or fused silica capillary column GC/MS to identify significant unknown compounds. This method will not be USATHAMA/PMO Certified (See Section IV of the RMA Procedures Manual for method).

4.2.11 <u>Nontarget Compounds</u>

The total ion current profile for GC/MS methods (volatiles and semivolatiles) will be screened for all major nontarget peaks. The laboratories will report all nontarget analytes with peaks greater than 10 percent of the internal standard response (giving RT [Retention Time] Code, estimating concentrations and printing MS [Mass Spectral] traces). Each of these major peaks greater than 10 percent of the internal standard response (excluding obviously meaningless peaks, e.g., column bleeds) will be reported as the purity, fit, and probability to match for the three most likely candidate compounds from the EPA/NBS/NIH Mass Spectral library computer program.

4.3 SOIL GAS

Soil gas methods have been developed by numerous firms, three of which have been utilized at RMA: Tracer Research Corporation of Tucson, Arizona; PETREX of Golden, Colorado; and Target Environmental Services of Denver, Colorado. All three methods provide quick and relatively inexpensive definition of volatile contaminants in the vadose zone.

Soil gas methods rely on the migration upward through the vadose zone to the atmosphere of volatile organic compounds present in the groundwater or vadose zone. This movement is created by the concentration gradient between the contaminated zones and the (essentially) contaminant free atmosphere. Soil gas sampling mechanisms intercept these volatile contaminants as they move through the vadose zone. Because this is a diffusion process, contaminant concentrations in the soil gas are highest near the contaminated zones. Although none of the three soil gas methods provides a direct measurement of the contaminant concentration in the soil or groundwater, the concentration of the contaminant in the soil gas does give an indication of the relative magnitude and areal extent of contamination. All three methods have been used successfully at contaminated sites at RMA to detect sources and trace plumes of volatile organic compounds. Two of the methods, Tracer and PETREX, were successful in detecting volatile organic compounds present in the vadose zone and groundwater during a program conducted by Ebasco at RMA (Ebasco, 1986). Soil surveys can be used as a low cost reconnaissance tool from which more expensive drilling and sampling programs can be planned more efficiently.

Detailed descriptions of PETREX and Tracer soil gas methods can be found in the Task 38 Technical Plan (Ebasco, July 1986).

4.3.1 Target Environmental Services, Inc.

Target Environmental Services, Inc. utilizes a dynamic/extraction process which consists of a stainless steel probe driven to depths of 1 to 4 ft, depending on conditions. After the probe is in place, evacuated glass vials are filled with soil gas collected through inlets located near the bottom of the probe. After the vials have been filled with soil gas, they are sealed and delivered to the laboratory where the appropriate analyses are conducted using a gas chromotograph equipped with electron capture, flame ionization, photo ionization, or thermal conductivity detectors. When detailed speciation information is required to identify transport mechanisms or pollutant attenuation, or to determine the contaminant contributions of multiple sources, the analysis is conducted using a GC/MS. Elapsed time for this analysis is less than two weeks.

Two Army spill sites (Spill Site No. 9 and Spill Site No. 18) are designated for preliminary soil gas screening. Spill Site No. 9 may have involved hydrocarbons (fuel), and Spill Site No. 18 possibly involved solvents and paints. Both of these types of contaminants are detectable by the soil gas method.

Ebasco will be using the Target Environmental Services soil gas method at the Task 24 sites, rather than the PETREX or Tracer methods, for the following reasons:

1. The soil gas screening program for Task 24 will be conducted during the winter. Ebasco's experience (winter 1986) has shown that retrieving PETREX's glass sample tubes from frozen soil is extremely difficult. Sample containers may break when they must be chipped out of ice, causing a significant loss of samples. Target's methods involve a stainless steel probe which is driven into the soil and then removed for each sample. This method reduces breakage and is less labor-intensive.

2. PETREX samples are left in the soil for up to 1 month. Target samples are removed immediately, and analysis time is less than two weeks. Thus, usable information will be available sooner, allowing more time to develop the boring program at these sites.

3. Tracer samples can be analyzed for only a limited number of related analytes per sample evacuation, and these analytes must be predetermined before the sample is taken so that the analytical equipment can be properly calibrated. By contrast, Target samples can be analyzed for a large variety of contaminants, as their equipment does not require field calibration. These features are useful when the chemical constituents that may be present are not precisely known, as is the case at Spill Site No. 18.

4. Target sample containers can be safely stored after initial analyses for over 2 months, allowing further analysis for new analytes without costly additional field work. This may be advantageous for spill sites where new data indicate previously unsuspected contamination.

5. Because the study areas proposed for soil gas screening under Task 24 are relatively small, Target appears to be more economically feasible than Tracer. Tracer is often more cost effective in relatively large study areas, because Tracer utilizes real-time sampling and analytical methods. Utilizing the Tracer method, once contamination is detected, sampling efforts can be concentrated upon the contaminated area, and the sampling density in less contaminated areas can be decreased. However, this advantage diminishes as the study area size decreases. For sites involving small areas, the real-time directed sampling techniques do not offer much of an advantage in minimizing the number of samples needed. Since the cost of each of Tracer's samples is approximately twice that of Target samples, the advantage in small study areas (such as those proposed under Task 24) shifts to Target.

4.3.2 Control Points

In addition to the soil gas sampling proposed at Spill Sites No. 9 and No. 18, four control areas, consisting of 3 sample points each, will also be sampled. Analyses from these control areas will give background information on soil gas constituents that may not be unique to each spill site, but rather uniformly present in the South Plants area due to even dispersion and/or groundwater contributions. In order to obtain data pertinent to the spill site study, the control areas will be located using the following criterion:

1) Geological material similar to that present at the spill site.
2) Depth to water similar to that present at the spill site.
3) No visible evidence of contamination at the surface. (This will reduce the possibility of obtaining data that is unrelated to the spill site.)

In addition to the above criterion, one control area will be located hydrologically upgradient from each spill site. This will provide information on the extent to which groundwater moving into the site is contributing to the analytes detected at the site. Another control area will be located hydrologically downgradient of each spill site. This will provide information on the extent to which the site may be contributing contamination to the groundwater. A final control area will be chosen in an area already shown to be contaminant free by soil samples and groundwater samples. This control area will provide information on the sensitivity of the soil gas technique and the levels of contamination expected from exposure to ambient air and normal handling or transport.

5.0 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

5.1 PROJECT QA/QC PLAN FOR THE ARMY SPILL SITES PROGRAM

An integral part of this Task 24 Technical Plan is the project specific Quality Assurance/Quality Control Plan describing the application of Ebasco's procedures to monitor and control field and analytical efforts at RMA. Ebasco has developed a Project QA/QC Plan applicable to geotechnical, sampling and analytical activities. For Task 24, Ebasco will adhere to and comply with the established QA/QC requirements. The plan is presented in the RMA Procedures Manual Volume II (Ebasco, 1985b). The specific objectives of the Ebasco Quality Assurance Program for RMA are to:

- Ensure adherence to established PMO QA Program guidelines and standards;
- Ensure precision and accuracy of measurement data;
- Ensure validity of procedures and systems used to achieve project goals;
- Ensure that documentation is verified and complete;
- Ensure that deficiencies affecting data quality are quickly determined;
- Perform corrective actions that are approved and properly documented;
- Ensure that the data acquired will be sufficiently documented to be legally defensible; and
- Ensure that the precision and accuracy levels attained during the USATHAMA/PMO analytical certification program are maintained during the project.

The overall project QA/QC responsibility rests with the Project QA/QC Coordinator. He/she will be assisted by the Field and Laboratory QA/QC Coordinators. The Field QA/QC Coordinator will assure that all quality control procedures are implemented for drilling, sampling, chain-of-custody, and documentation. He or she will be responsible for:

- Reviewing all field monitoring data and documentation for completeness and accuracy;

- Assuring that chain-of-custody, sample security, and document security procedures are followed;

- Determining defiencies in implementation of drilling and sampling quality control protocols and seeking corrective action;

- Preparing weekly reports to the Project Quality Assurance Coordinator of problems and corrective actions;

- Making documentation available for review by Ebasco Project Quality Assurance Coordinator or USATHAMA during audits;

- Training field personnel in the implementation of procedures for data coding; and

- Reviewing all completed field data coding sheets for compliance with USATHAMA requirements.

Ebasco is using two laboratories for the performance of chemical analytical services. Both laboratories will comply with the Project QA/QC Plan. Each laboratory has appointed a Laboratory QA/QC Coordinator. Their responsibilities include:

- Monitoring the quality control activities of the laboratory;

- Recommending improvement in laboratory quality control protocol, when necessary;

- Logging in samples, introducing control samples in the sample train, and establishing sample testing lot sizes;

- Approving all data before submission to permanent storage;
- Maintaining all quality control records and chain-of-custody documents;
- Assuring document and sample security;
- Informing Ebasco's Project QA/QC Coordinator of non-compliance with the Project QA/QC Plan; and
- Preparing and submiting a weekly report of quality control data to the Ebasco Project QA/QC Coordinator.

Prior to conducting the field program, QA/QC training will be provided by the Project QA/QC Coordinator to indoctrinate field, laboratory, and project personnel in the specific procedures detailed in the Project QA/QC Plan.

Also, prior to analysis of samples, the Project QA/QC Coordinator will visit the laboratories to review analytical procedures with chemical analysis personnel and instruct the Laboratory QA/QC Coordinators in the requirements of the Project QA/QC Plan and data validation procedures. In addition, the Project QA/QC Coordinator will perform audits of field and laboratory work on a bi-monthly basis to ensure compliance with the Project QA/QC Plan. Specific project QA/QC requirements are described in the following sections.

5.2 SPECIFIC TASK REQUIREMENTS

5.2.1 <u>Geotechnical Requirements for Army Spill Sites</u>

The geotechnical requirements for borehole logging are described in Section 7 of the QA/QC Plan (Ebasco, 1985b) and based on Army guidelines (USATHAMA, 1983). Ebasco will have a geologist present at each operating drill rig who will be responsible for logging samples and monitoring drilling operations.

5.2.2 Field Sampling

The management of samples, up through the point of shipment from the field to the laboratory, will be under the supervision of Ebasco's Field QA/QC Coordinators (FQA/QC). Samples will be collected in properly cleaned containers, labeled, preserved and transported according to the prescribed methods. Section 8.0 of the Project QA/QC Plan describes the procedures to monitor adherence to approved sampling protocol. If the FQA/QC determines that deviations from the sampling protocol have occurred, resulting in a compromise of the sample integrity, all samples taken prior to the inspection will be discarded and fresh samples will be taken. The FQA/QC is responsible for field chain-of-custody documentation and transfer, and will supervise the strict adherence to chain-of-custody procedures.

5.2.3 Laboratory Quality Assurance Procedures

Section 10 of the Project QA/QC Plan describes the Laboratory Quality Assurance Procedures. Both laboratories, along with their internal quality assurance program, will adhere to the Project QA/QC Program.

The Laboratory QA/QC Program begins with the receipt of the samples from the field. All samples will be shipped to DataChem for logging in, sample splitting, and distribution for analyses. The Laboratory QA/QC Coordinator is responsible for monitoring the laboratory activities. He is also responsible for determining testing lot sizes and introducing laboratory control samples into the testing lot in an inconspicuous manner.

The samples must be analyzed within the prescribed holding time by the approved analytical methods. Analytical methods are described in Section 4.0 of this Technical Plan.

5.2.4 Laboratory Analytical Controls

Daily quality control of the analytical systems ensures accurate and reproducible results. Careful calibration and the introduction of the control samples are prerequisites for obtaining accurate and reliable results. Procedures for instrument calibration and analytical controls are described in Section 12 of the Project QA/QC Plan.

The Laboratory QA/QC Coordinator (LQA/QC) for each laboratory will monitor the analytical controls. The out-of-control situation can be detected by the control charts.

When an out-of-control situation is detected, efforts will be initiated to determine the cause. Corrective actions will be taken to bring the process under control. Full documentation of an out-of-control situation and the subsequent corrective action will be recorded by the LQA/QC Coordinator.

5.2.5 Laboratory Data Management, Data Review and Validation, and Reporting Procedures

Sections 13 through 16 of the Project QA/QC Plan detail the procedures for laboratory data review, validation and reporting procedures. The laboratories utilize highly automated system for analytical data collection and reduction. The analytical supervisor, with the LQA/QC Coordinator, reviews all analytical data after data reduction and prior to the transfer of the data report to Ebasco. The laboratory data reporting procedure is described in Section 15 of the Project QA/QC Plan which is based on the established PMO reporting procedures for analyses performed at quantitative and semi-quantitative levels. The laboratories will adhere to these reporting procedures.

6.0 DATA MANAGEMENT PROGRAM

6.1 ARMY SPILL SITE PROGRAM

This section presents the data management procedures to be used by Ebasco for the Army Spill Site Program portion of Task 24. As specified in the contract, all data from the Army Spill Site field sampling program will be presented to PMO in appropriate format and entered into the IR-DMS (Installation Restoration - Data Management System) UNIVAC 1100/60. PMO has provided a Tektronix 4051 system and IR Data Management User's Guide, Version 85.6 (PMO, 1985) to Ebasco for this purpose. Data will be controlled as necessary. Presentation of project management data and report communication is discussed in Ebasco's Management Plan.

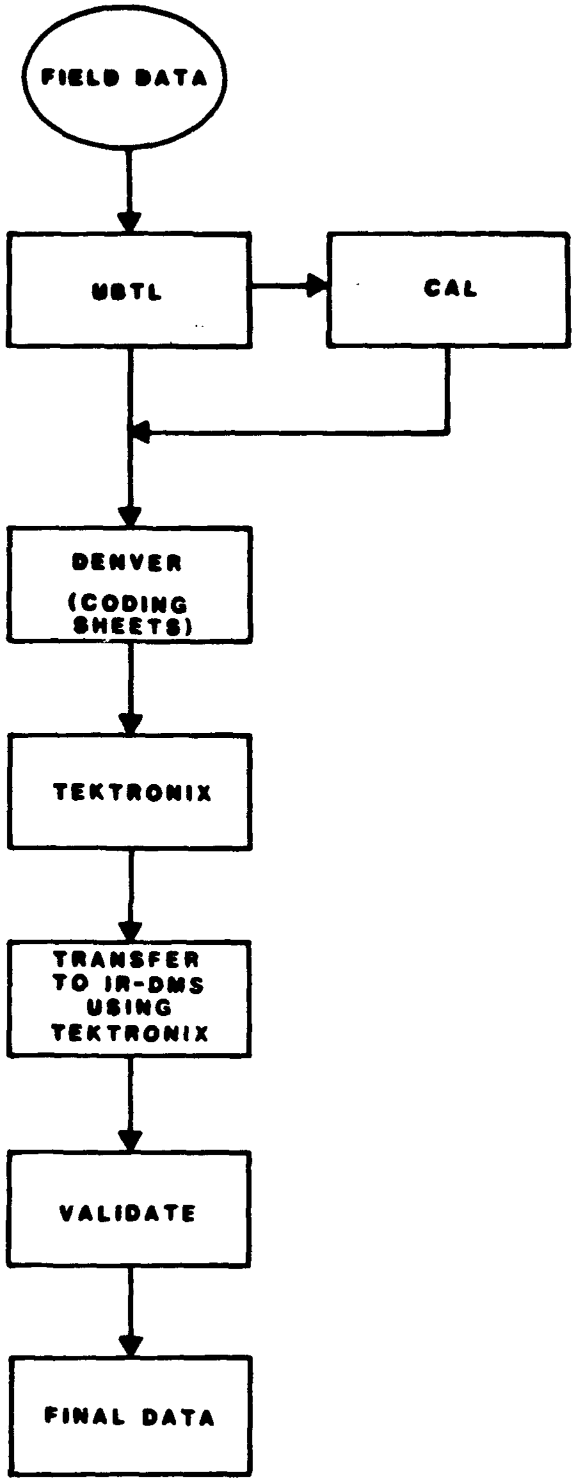
Figure 24-30 shows schematically the process Ebasco will use to coordinate data management activities between itself, UBTL, CAL and IR-DMS. As shown in Figure 24-31, Ebasco's primary data entry terminal for the IR-DMS will be through the Army owned Tektronix terminal in Ebasco's Denver office. A second Army owned terminal is maintained in Ebasco's Santa Ana office for backup data entry purposes. Specifics of data collection, data entry, data validation, and data analysis are discussed herein.

6.2 FIELD ACTIVITIES

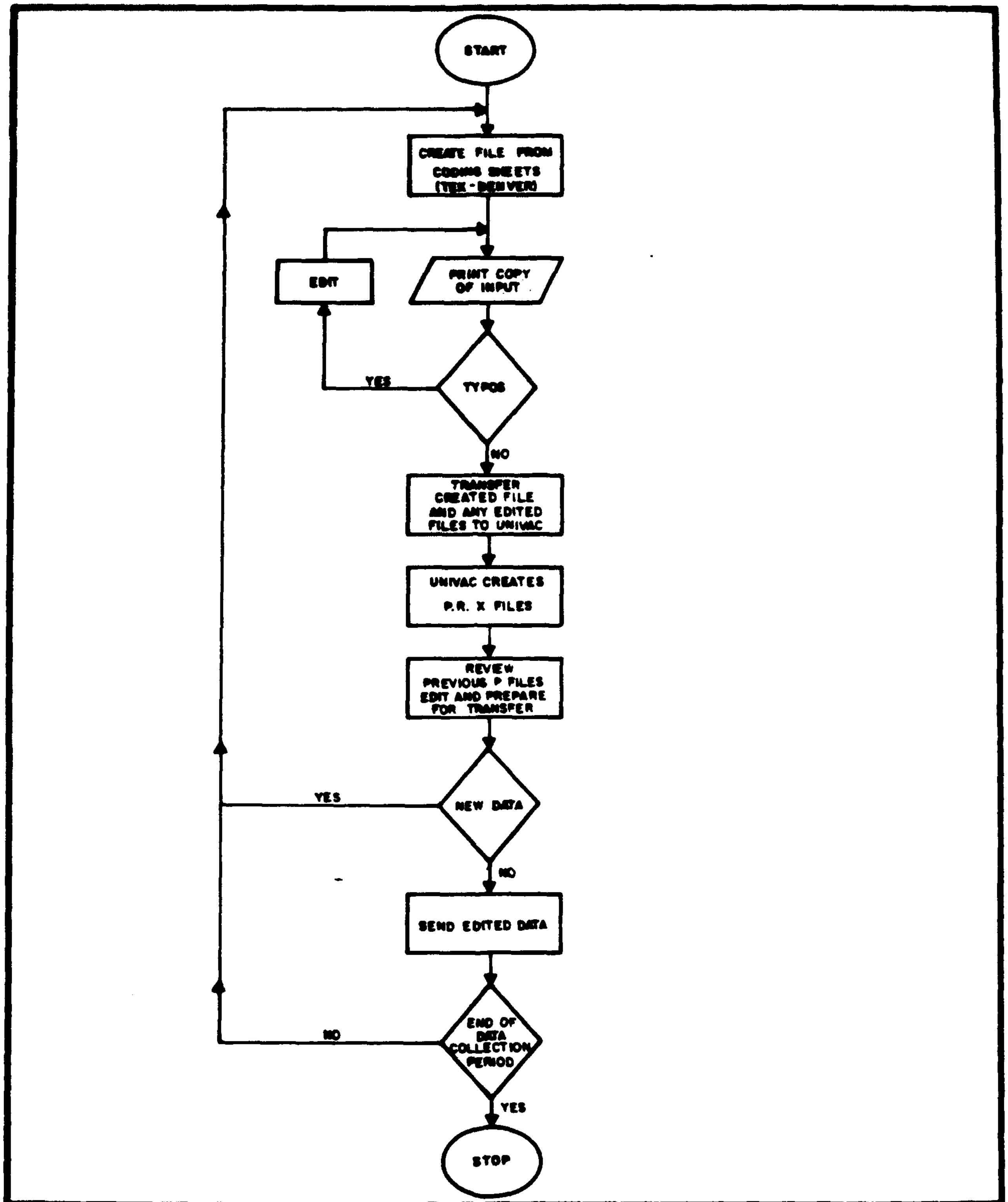
6.2.1 Sample Handling

The Sample Coordinator is responsible for field data collection and logging of the sampling program. In addition, the Sample Coordinator will assure that all field data are properly accounted for and transferred to the data manager for input into the computer at Ebasco's Denver office. To accomplish this, the Sample Coordinator will assure that proper sample collection procedures, sample control identification procedures, and proper chain of custody procedures are followed.

Sample control identification numbers will be assigned by the Sample Coordinator to each sample collected in the field. These sample identifiers are to be recorded on the sample tag in the field data log book and on the



Prepared for: Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	FIGURE 24.30 **Data Flow Between Ebasco, UBTL, CAL and IR-DMS** Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated



Prepared for:

Program Manager's Office for
Rocky Mountain Arsenal Cleanup
Aberdeen Proving Ground, Maryland

FIGURE 24.31
Laboratory Data Flow to the IR-DMS UNIVAC 1100/61 System
Rocky Mountain Arsenal, Task 24
Prepared by: Ebasco Services Incorporated

sample chain of custody record at the time of sample collection. The chain-of-custody record will also serve as the analytical request form, verifiable by the analytical request list on the sample tag. The Sample Coordinator will check sample tags, chain-of-custody forms, and field data logs to ensure complete and correct field data entry. Field identification numbers will remain with each sample throughout the data collection, shipment, analysis, and report phases of the program.

As part of the logging in of field data, the Sample Coordinator will copy each chain of custody form onto the field notebook, package and seal the samples for shipment to the laboratory, and assure the shipment of these samples. The Sample Coordinator will forward the necessary written field records to the Data Coordinator at Ebasco's Denver office for entry into the computer.

6.2.2 Geotechnical Program

Geotechnical boring logs containing pertinent data regarding borehole lithology will be coded immediately upon receipt from the field onto PMO data coding sheets. These data will be entered into the Field Drilling Files by the Ebasco Denver office.

Upon completion of the drilling of borings at each site, a surveying crew will determine map coordinates and ground elevations for the location of each boring. These survey data will be coded immediately onto PMO data coding sheets, and will be entered into the IR-DMS Map Files by the Ebasco Denver office. It is critical that these files be entered into the data management system before the completion of chemical analyses, as each sample location must be associated with a map location.

6.2.3 Laboratory

When samples are received at DataChem, the sample receipt officer will sign the chain of custody record, log in the sample shipment, verify the sample integrity, assign sample lots, prepare split samples, and identify samples to be sent to CAL or to be retained by DataChem for chemical analysis. Each laboratory will submit weekly sample status reports to Ebasco's data manager. This weekly status report will be used to aid in planning the rate of field sampling and the distribution of laboratory workloads.

Field and laboratory sample control identification and chemical analysis data will be transcribed to the data coding sheet by DataChem and CAL, then verified using the program's laboratory control procedures. The verified data coding sheets will then be delivered, by courier, to Ebasco's data manager for entry into the IR-DMS data base.

6.3 DATA ENTRY AND VALIDATION

Figure 24-31 illustrates the flow of data to enter laboratory results into the IR-DMS Univac 1100/60. The first step in data entry will be to create a magnetic tape copy of the coding sheets on the Tektronix 4051 terminal by keypunching. The Tektronix operator will enter only a subset of a complete file at one time. These file subsets will later be merged to a single file using the UNIVAC. After data entry, the operator will obtain a printed copy of the data subset using the Tektronix printer, and will verify that the data in the Tektronix tape file is identical to that on the coding sheets. The operator will correct any data entry typographic errors using the Tektronix editor, then obtain a second printing of the file to confirm that the changes were properly made. Methods certification data and map location data will be entered first because validation routines make use of this information.

Once the operator is certain that there are no remaining data entry errors on the Tektronix tape, the operator will use the Tektronix 4051 as a remote terminal to transfer the data to the UNIVAC 1100/60. To do this, the operator will load the data entry software, catalog a Level 1 (preacceptance) file on the UNIVAC, and transmit the data over the telephone lines using a modulator-demodulator (modem). Ebasco's operators will transfer Tektronix entry tape files to Level 1 UNIVAC files at least once per week.

Next, the operator will invoke the IR-DMS data acceptance routines to perform the final data verification and create a Level 2 (temporary read-only) file. The acceptance routines will identify any errors in format or coding and any inconsistencies with corresponding map records previously loaded. If the acceptance routine does find errors at this stage, the operator will check the "R" file. The "R" file contains the rejected records that the acceptance routine creates. The UNIVAC editor is used to correct the verified entries, then they are rerun through the data acceptance routines. After acceptance, the IR-DMS automatically creates chemical and geological Level 2 files. Ebasco's operators will run the Level 1 data files through the data acceptance routines within seven days of their transfer to the UNIVAC system. They will delete Level 1 files once these data are accepted at Level 2.

The final step in the data entry and validation process, the creation of a Level 3 (final version, read-only) file, is undertaken by the PMO APG-EA data processing staff.

USATHAMA's data management contractors are in the process of developing a PC-based data entry system that Ebasco plans to utilize once it is functional.

6.4 ANALYSIS AND PRESENTATION

Ebasco scientists will access the PMO IR database and will perform analyses as required to support all contamination assessment work. The data analysis efforts will include graphic representations of data using data gridding, contouring, and three-dimensional surface representations. (Specifics of the contamination assessment work are presented in Section 8.0)

Several techniques will be used to access the data. PCs will be used in terminal emulation mode to capture Level 3 data from the IR data base in order to perform analyses and prepare material for presentation. Analytical results captured from the IR database will be maintained in Ebasco database files on the PCs for use during contamination assessment. The Tektronix

4051 terminals in Denver and Santa Ana will also be used in a direct link to the UNIVAC. Ebasco scientists may establish communication links between IBM PCs to interchange data and facilitate data analysis.

7.0 HEALTH AND SAFETY PROGRAM

7.1 GENERAL

7.1.1 Project Health and Safety Plan

A draft of the project Health and Safety Plan (HASP), prepared according to the Ebasco Corporate Health and Safety Program, is included in the RMA Procedures Manual, Volume III (Ebasco, 1985b). The purpose of this section is to provide an overview of the safety program that Ebasco will employ to ensure the safety of its employees and that of subcontractors engaged in field investigations at the RMA. All personnel working at the RMA are, or will be, familiar with this document and are, and or will be, indoctrinated in all aspects of the safety program.

In particular, the following issues are important to the field investigation work.

- Safety organization, administration and responsibilities
- Initial safety assessment and procedures for hazard assessment
- Safety training
- Safety operations procedures
- Monitoring procedures
- Safety considerations for sampling
- Emergency procedures
- Confined space or limited egress procedures

Overall responsibility for safety during the site investigation activities rests with the Project Health and Safety Officer. The Officer is responsible for developing the site-specific HASP at the RMA, and through the onsite Health and Safety Coordinator assumes responsibility for its implementation. Specifically, the Officer and staff are responsible for:

- Characterizing the potential specific chemical and physical hazards that may be encountered;

- Developing all on-site safety procedures;

- Assuring that adequate and appropriate safety training and equipment are available for project personnel;

- Arranging for medical examinations for specified project personnel;

- Arranging for onsite emergency medical care and first aid to be available, as necessary;

- Determining and posting locations of and routes to site work zones;

- Notifying installation emergency officers (i.e. police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members; and

- Indoctrinating all team members in safety procedures.

In implementing this safety program, the project Health and Safety Officer will be assisted by a field Health and Safety Coordinator whose function is to oversee the proper adherence to the established health and safety program procedures. The details of the safety program organization, administration, and responsibilities are described in Section I and II of the HASP.

7.1.2 Task 24 Health Hazards

The degree of hazard will likely be extremely variable, and will depend on the location being assessed and its operational history. Many of the contaminants that may be present at locations to be investigated during this task are known to be toxic and hazardous to human health.

Section VI of the HASP describes the procedures employed to determine the hazard of a specific building or a sampling location and to identify the required initial level of protection.

7.1.3 Training

Section VII of the HASP explains the training program that is planned for the RMA project. The training will focus on general health and safety considerations and provide site-specific safety instructions.

7.1.4 Safety

Section VIII of the HASP describes in detail the safety operations procedures. The important aspects of the safety operations procedures are:

- Zone approach for field work
- Personnel protection
- Communications

A three-zone approach (Support Zone, Contamination Reduction Zone, and Exclusion Zone) will be used for field work at the RMA where appropriate. The Support Zone will contain the Command Post with appropriate facilities such as communications, first aid, safety equipment, support personnel, hygiene facilities, etc. This zone will be manned at all times when the field team is operating downrange. Adjacent to the Support Zone will be the Contamination Reduction Zone (CRZ) which will contain the contamination reduction corridor for the decontamination of equipment and personnel. (The actual decontamination procedures are discussed in Section X of the HASP). All areas beyond the CRZ will be considered the Exclusion Zone, which is an area where unauthorized personnel may not enter. During soil boring operations, the Exclusion Zone will be established as a 30 ft radius from the drill rig. These support activities are discussed and illustrated in Section VIII of the HASP.

The level of protection to be worn by field personnel will be defined and controlled by the onsite Health and Safety Coordinator and will be specifically defined for each operation in a Facility Information Sheet (FIS). The preliminary FIS will be developed based upon historical information and data and will be upgraded before subsequent operations based upon the results of the Health and Safety portion of the Soil Sampling programs. For these programs, Level "C" type protection will generally be provided for investigation team members; however, Level "D" type protection may also be used as appropriate, based on assessment by the Health and Safety Officer and the onsite Health and Safety Coordinator. If necessary, changing from Level "D" to "C" protection can be achieved easily in the field. Basic levels of protection (i.e., Levels "A", "B", "C" or "D") for general operations are defined in Section VIII of the HASP.

Maintaining proper communications among team members (investigation team and Health and Safety team members) during field investigation work is of utmost importance for the protection of team members. The methods of communication employed will be:

- Walkie-talkies
- Air horns
- Hand signal
- Voice amplification system

For external communication, telephones and sirens will be used.

7.1.5 Monitoring

Section IX of the HASP explains the health and safety monitoring procedures. The working environment will be monitored continuously to ensure an adequate level of personnel protection. Depending on the history of the sampling location, the following parameters will be monitored:

- Army agents
- Oxygen level
- Explosive conditions
- Organic vapor levels
- Inorganic gas levels
- Dust

The type of onsite monitoring instruments to be utilized includes, but is not limited to, the following, and will be selected according to what contaminants are expected to be present:

- o M18A2 Chemcial Agent Kit for Army agents
- o M8 alarm for nerve agent
- o Oxygen meter for oxygen level
- o Combustible gas indicator for explosive condition
- o PID and FID meters for organic vapors
- o Gold film mercury monitor, a chlorine monitor, a carbon monoxide monitor, and a hydrogen sulfide monitor, for inorganic gases

Based on the monitoring results (real-time and field or laboratory analyses of the health and safety samples), the on-site Health and Safety Coordinator can halt field investigation work and upgrade or downgrade the level of personal protection.

7.1.6 Sampling

Section IX of the HASP explains the safety considerations during sampling. It describes the safety procedures to be followed for drilling operations, soil, surface water and liquid waste sampling, building sampling, and sampling in a confined space.

7.1.7 Emergency Procedures

The emergency procedures are described in Section XII to XIV of the HASP. Section XII explains the basic emergency scenarios and activities to be undertaken during each of these emergency situations; Section XIV describes the summoning of emergency services (i.e. medical, fire protection, ambulance, etc.) outlines the evacuation procedures to be followed in case of fire, explosion, or a significant release of toxic gases.

7.1.8 Confined Space or Limited Egress Procedures

The determination of a confined space or limited egress enclosure will be made by the on-site Health and Safety Coordinator. The configuration of the space and the proposed operation to be conducted within that space will ultimately be used to determine if a confined space or limited egress condition exists. The procedures to be followed are outlined in Attachment 7 of the HASP.

7.2 TASK-SPECIFIC HEALTH AND SAFETY PLAN (HASP)

A task-specific HASP will be developed by the Project Health and Safety Officer who, through the on-site Health and Safety Coordinator, assumes responsibility for its implementation.

Health and safety considerations will be developed for the specific operations to be conducted for this task, based on the evaluation of past activities, incidents, accidents, and investigations. In particular, the following areas will be addressed to ensure the health and safety of employees and subcontractors involved in field investigative activities.

- Initial assessment and procedures for hazard assessment
- Safety operations procedures
- Monitoring procedures
- Safety considerations for sampling
- Emergency procedures
- Confined space or limited egress procedures

8.0 CONTAMINATION ASSESSMENT

The objectives of the Contaminant Assessment Program, of which Task 24 (Spills) is a Phase I component, are to identify the contaminants present; assess the extent of contamination; evaluate the factors that govern contaminant distribution at the Army spill sites; determine the severity and significance of the contamination; and develop a Phase II program, if necessary.

Phase I investigations will be conducted at each potential source area to evaluate whether the sites are contaminated, and if so, the types of compounds and metals present at each site. The Phase I studies of the Army spill sites will be accomplished through a limited number of borings; samples from these borings will be screened for target analytes. In concert with information gained through other tasks (particularly the South Plants Regional Study and the Shell spill sites study under Task 2), the Phase I program will provide sufficient information to design remedial action concepts.

8.1 ARMY SPILL SITES

In order to accomplish the objectives of the overall program, the contamination assessment in Phase I will consist of the following subtasks:

1. Determination of the type, magnitude, distribution, and extent of contamination;

2. Examination of the geologic and hydrogeologic influence on the spatial distribution of contaminants; and

3. Estimation of the significance of soil contamination (criteria development).

8.1.1 Type, Magnitude, Distribution, And Extent of Contamination

The results of the soil gas and soil boring analyses will be examined to determine the presence, quantities, and extent of contamination within the Task 24 (Spills) sites. Compilation of soil-constituent data by source, location, and depth will provide information on the areal and vertical extent of contamination. The chemical data will be integrated with the soils and geohydrologic data as described in Section 8.2. From this information, the types and concentrations of contaminants, estimates of their lateral and vertical extents, and definition of their boundaries will be evaluated.

The data obtained during Phase I of Task 24 (Spills) sampling, along with data collected under other studies, as appropriate, will be used to determine the requirements for additional borings. Maps and cross-sections will be prepared to illustrate the spatial distribution and to delineate the existence of distinct contaminant concentration gradients around spill sites and within the overall study areas.

8.1.2 Factors Influencing Contaminant Distribution And Mobilization

8.1.2.1 Geologic and Hydrologic Conditions

The hydrological data will be analyzed in conjunction with the historical information to determine the influence of the subsurface geology and hydrology in the distribution of contaminants in the ambient soils of the study areas.

Borehole logs will be compiled, integrated, and interpreted to formulate a site-specific evaluation of geologic conditions. Hydrogeologic conditions of the Task 24 (Spills) areas will be assessed following the evaluation of previously generated hydrogeologic data and data collected during this investigation. The groundwater flow and direction within the Task 24 (Spills) areas will be estimated.

8.1.2.2 Contaminant Properties and Geochemistry of Ambient Soils

The distribution and mobilization of contaminants are functions of both the molecular characteristics of the target chemicals and the physical and chemical, properties of the soils. These variables will be examined, as applied to the contaminants of concern and the soil characteristics observed during drilling, and used in the data analyses to evaluate the contribution of these factors to the observed gradients.

8.2 RELATIONSHIP OF CONTAMINATION SOURCES TO PAST AND PRESENT SOIL CONTAMINATION

The analysis of the spill sites and soils data will be used to identify relationships between the ambient soil and potentially contaminated areas. These methods will allow an estimate of the spatial extent of contamination and define the areas which may require cleanup. In addition, these analyses will identify the need for additional soil borings (increase in sampling density or change of grid configuration) to better delineate the contamination boundaries.

9.0 SCHEDULE

The project schedule for Task 24 is shown in Figure 24-32.

PROJECT SCHEDULE
TASK 24 -- VOLUME I (SPILLS)
ROCKY MOUNTAIN ARSENAL

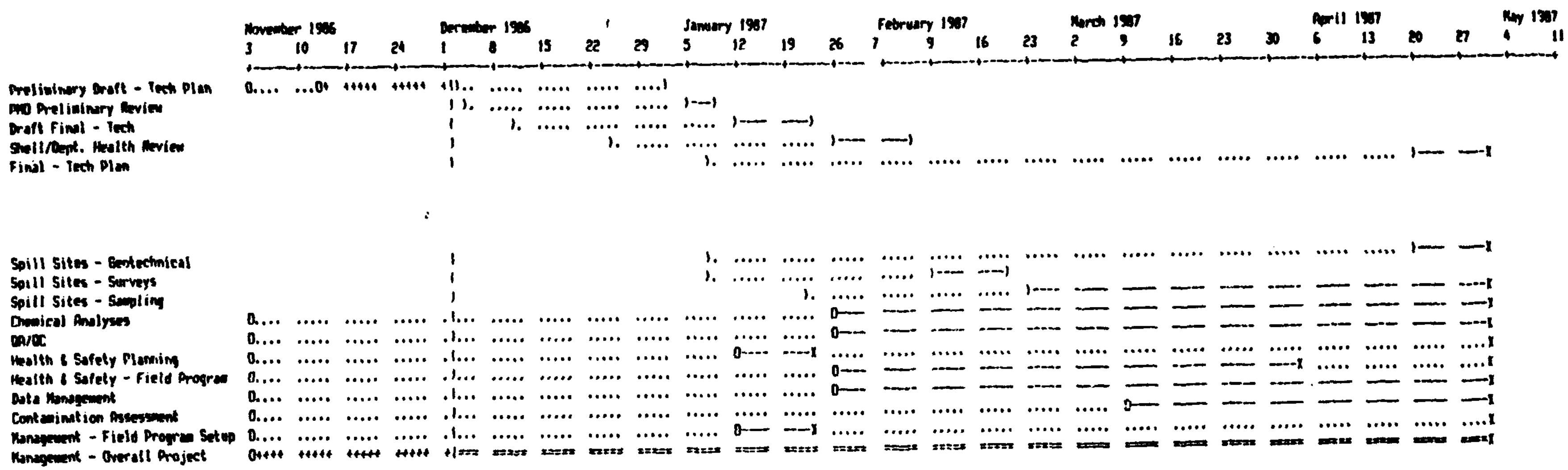


Figure 24-32

10.0 REFERENCES

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Volume I

Appendix 24-A

Pesticides Stored in Building 544

on October 6, 1975

APPENDIX A

Pesticides Stored in Building 544 on October 6, 1975

PESTICIDE	NSN	QUANTITY
Copper acetoarsenite		5 lbs
Chlordane	6840-00-270-8262	9 lbs
Lindane	6840-00-242-4213	10 lbs
DDT Powder		50 lbs
Dieldrin granules		2 lbs
Malathion	6840-00-685-5437	124 gals
Diazinon	6840-00-782-3925	14 gals
Diazinon	6840-00-844-7355	14 gals
Diazinon	6840-00-753-5038	197 lbs
Vapona		140 strips
Naled	6840-00-926-9163	22 gals
Carbaryl		100 lbs
Propoxur		1 gal
Baygon Propoxur	6840-00-498-4057	5 lbs
Pyrethrum		64 ozs
Pyrethrum Roach Powder		5 lbs
Warfarin	6840-00-575-4973	128 lbs
Strychnine Grain		38 lbs
Poison Grain		25 lbs
Anticoagulant Dusting Powder		5 lbs
Calcium Cyanide		5 lbs
Diquat	6840-00-815-2799	17 gals
Diuron		5 gals
Diuron		50 lbs
Borate-Bromacil Mixture	6840-00-027-6467	597 lbs
Simazine		20 lbs
Bordeaux Mixture		52 lbs
2, 4, 5-T	6840-00-577-4201	25 gals
2, 4-D	6840-00-926-9093	272 gals

APPENDIX-A (Continued)

PESTICIDE	NSN	QUANTITY
2, 4-D and 2, 4, 5-T	6840-00-926-9095	209 gals
Sodium 2,2-dichloropropionate		30 lbs
Thiram		2 lbs
Boric Acid		10 lbs

(U.S. Army Environmental Hygiene Agency, 1975; Marlow, 1986).

On February 7, 1979, the following pesticides were stored in the Pest Control Shop area:

Pesticide	Amount	Location
797-A Powdered Insecticide, pyrethrine 1%, silica gel 40%	84 oz.	Building 544
Aranan 75 thiram 75%	2 lbs	Building 544
Arsenate of Lead	2 lbs	Building 544
Baygon Roach Bait propoxur 2%	2.5 lbs	Building 544
Cyanogas-A Calcium Cyanide 42%	1 lb	Building 544
Dieldrin Granules, 5%	2 lbs	Building 544
Experimental Anticoagulant Dusting Powder calcium salt of 2-substituted 1,3 indandione 2.174%	4.5 lbs	Building 544

Pesticide	Amount	Location
Herbicide Dimethyl Tetrachloroterephalate Dacthal W-75 DCPA 75% 6840-00-681-9475	108 lbs	Building 544
House Mouse, Meadow Mouse, and Pocket Gopher Bait Strychnine alkaloid 0.5%	40 lbs	Building 544
Insecticide Diazinon EC, 47.5%, 6840-00-784-3925	5.5 gal	Building 544
Insecticide Diazonon EC, 48.2%, D-Tox 4E 6840-00-782-3925	1 gal	Building 544
Insecticide Diazinon Liquid Residual, 0.5% 6840-00-844-7355	2 gal	Building 544
Insecticide Powder Roach sodium fluoride 47.5% pyrethrins 0.2%	5 lbs	Building 544
Insecticide Pyrethrin, 0.6% 6840-00-823-7849	324 ozs	Building 544
Paris Green, Copper aceto arsenite 85.4%	5 lbs	Building 544

APPENDIX-A (Continued)

Pesticide	Amount	Location
Herbicide Dimethyl Tetrachloroterephalate Dacthal W-75 DCPA 75% 6840-00-681-9475	108 lbs	Building 544
House Mouse, Meadow Mouse, and Pocket Gopher Bait Strychnine alkaloid 0.5%	40 lbs	Building 544
Insecticide Diazinon EC, 47.5%, 6840-00-784-3925	5.5 gal	Building 544
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Insecticide Pyrethrin, 0.6% 6840-00-823-7849	324 ozs	Building 544
Paris Green, Copper aceto arsenite 85.4%	5 lbs	Building 544

APPENDIX-A (Continued)

Pesticide	Amount	Location
Radapon dalapon 82%	5 lbs	Building 544
Rid-A-Bird endrin 9.75%	1 pt	Building 544
Rodenticidal Bait Anticoagulant warfarin 0.025% 6840-00-753-4973	150 lbs	Building 544
Sevin Sprayable	220 lbs	Building 544
Carbaryl 80% 6840-00-932-7297		
Simazine 80W, 80% 6840-00-814-7334	17 lbs	Building 544
ULD BP-300 Insecticide pyrethrins 3%	10.5 gal	Building 544
Aldrin	110 gal	Outside Storage Shed
De-Pester Ded-Weed 2, 4-D 2, 4, 5-T	55 gal	Outside Storage Shed
Diquat Water Weed Killer diquat dibromide 35.3% 6840-00-815-2799	20 gal	Outside Storage Shed

APPENDIX-A (Continued)

Pesticide	Amount	Location
Insecticide Chlordane EC, 73.6% 6840-00-270-8262	2 gal	Outside Storage Shed
Insecticide Naled, 85% 6840-00-926-9163	14 gal	Outside Storage Shed
Insecticide Strip dichlorovos 6840-00-685-5437	140 strips	Outside Storage Shed
Herbicide 1, 4-D Thompson Weedicide Concentrate, dimethyl salt 2, 4-D acid 50% equivalent 2, 4-D acid 41.5% 6840-00-557-4202	55 gal	Outside Storage Shed
Zinc Phosphide on Steam Rolled Oats, 2%	250 lbs	Outside Storage Shed
Unknown	10 gal	Outside Storage Shed

(U.S. Army Environmental Hygiene Agency, 1979).

Volume I

Appendix 24-B

Pesticides, Herbicides, and Rodenticides Stored in Building 742 on January 3, 1986

APPENDIX B

On January 3, 1986, the following pesticides, herbicides and rodenticides were stored in Building 742:

Herbicide	Quantity
Simazine 80W WWP	3 bags/5 lbs. ea.
Sacthal W-75 WWP	4 bags/24 lbs. ea.
LWK #2 Weed Killer	1 Qt. Bottle
Diquat	17 ea./5 Gal Cans
Borocil Soil Sterilant	1 Bag/50 lbs.
Tordon 101 Mixture	1 ea./5 Gal Cans
Fertilome Lawn Fertilizer	48 ea./10 lb. Bags
Banvel 48.2%	30 ea./1 Gal Cans
Embark Plant Growth	
Regulator 28%	8 ea./1 Gal Cans
Ortho X-77 Spreader	4 ea./55 Gal Drums
2-4-D 50%	4 Ea./5 Gal Cans

Rodenticide	Quantity
Anticoagulant 0.3%	299 ea./1lb. Cans
Baygon Roach Bail 0.2%	1/4 lb.
Zinc Phospide	4 Bags/50 lbs. ea.
Phostoxin 55%	120 Bags/50 lbs. ea.
Fumitoxin 55%	48 Flasks/2 lbs. 3.28 oz. ea.

Pesticide	Quantity
Sevin Carbaryl WWP 80%	15 Bags/10 lbs. ea.
797-A-Powder Insecticide	8 bulbs/30 oz. ea.
Diazinon Concentrate	12 Gals.
47.5% E.C.	
Diazinon 0.5% Solution	1-1/2 Gal.
ULD BP 300 3.0% Solution	1-1/2 Gal.
ULD 20 Smoke Odor Counteract	1 Gal.

APPENDIX B

Pesticide	Quantity
ULD CS 85 Micro Generator	
Cleaning Solvent	1 Gal.
Insect Repellant (Personal Application)	17 ea. Dispenser/2 oz. ea.
Pyrethrum Roach Powder .2%	
Paris Green 85.4%	1 ea./5 lb. Can
Diazinon 4E 47.5%	14 Gal.
Naled 85%	3 Gal. Jar
Dibrom 14 (Naled)	Approx. 2 Gals
Malathion 57%	1 ea./55 Gal. Drum

(Marlow, 1986).

Volume I

Appendix 24-C

Letter Technical Plans,

Sites 9 and 18

L

EBASCO SERVICES INCORPORATED

EBASCO

143 Union Boulevard, Suite 1010, Lakewood, CO 80228-1824, (303) 988-2202

July 28, 1987
RMA24-EDEN-USA-T-014

Commander, Office of the Program Manager
for Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE/D. Borrelli
Building E4585 - DBL Trailer
Aberdeen Proving Ground
Maryland 21010-5401

SUBJECT: Letter Technical Plan for Task 24, Army Spill Site #9, #18.

Dear Darryl:

Enclosed is the letter report form of the technical plan for proposed soil sampling at Army spill Site #9, #18. Boring locations are based on results from the soil gas screening which was proposed in the Task 24 technical plan Vol. I. Please review this material and supply us immediately with any comments so that we may expedite drilling.

If I am not available, please talk with Brian Myller, Assistant Task Manager.

Sincerely,

Penelope L. Niland

Penelope L. Niland
Task 24 Manager

PN/mm
cc: D. Campbell
K. Blose
P. Chiaro
J. Keithley
K. Knirsch
DCC/Denver
DCC/Santa Ana
Chron File

0210v
Rev. 7/28/87

Letter Technical Plan
Task 24 - Rocky Mountain Arsenal
Army Spill Site #9

Background

Army spill Site #9 (Task 24 Technical Plan - Vol. I) is located at a fuel loading area south of Building 732 (Ebasco 1987). Historical literature indicates that spills occurred while tank cars were being loaded due to leaks from transfer lines or from overfilling (Pimple, 1975; Shell, 1985). Exact spill locations are not evident in the literature so an initial soil gas screening study was conducted in order to help delineate contaminated areas and direct the placement of soil borings if needed. Target Environmental Services provided field and analytical support for the study proposed in Vol. I of the Task 24 Technical Plan (Ebasco 1987). Upon receiving analytical results from the Target Survey, elevated soil gas contamination levels were noted in samples taken from the northernmost row of the original grid outlined in the Task 24 Vo. I Technical Plan (Ebasco, 1987). These results showed only the southern boundary of a contaminated soil gas plume and suggested that contamination could exist north of the originally sampled area. Further study was needed in order to determine the north, east, and west extent of this soil gas contamination. Ebasco has new in house soil gas capabilities that were considered less expensive than calling Target back for additional sampling. Thus, Ebasco conducted the follow up work which delineated the plume boundaries. The soil gas screening study has shown where fuel-contaminated soil is likely to exist and has resulted in the locations for two proposed soil borings.

Results of the Soil Gas Screening

Three areas of soil gas contamination were detected in the soil gas studies. The first, and smallest in areal extent, is located on the east side of Building 744 near a 55 gallon, above ground tank (Fig. 1). The second largest area of contaminated soil gas was detected near the railroad tracks, slightly east of the center point of Building 744 (Fig. 1). The largest area of contaminated soil gas is located in the gravelled and partly asphalted loading area south of Building 732 (Fig. 1).

Proposed Soil Sampling

Two borings are proposed to further characterize contamination discovered during the soil gas screening. The first boring will be located in the loading yard south of Building 732 (Fig. 1). It will be positioned in order to sample the area believed to have the highest contamination concentration. The second boring will be located on the east side of Building 744 adjacent to the 55 gallon, above ground tank. Both borings will be drilled to water table (anticipated to be 15 feet). Samples will be taken from the standard intervals plus the one foot section immediately above water table. Information from these borings will be used to interpret the vertical extent of contamination and to confirm the analytes detected by the soil gas study.

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Rev. 7/28/87

No borings are proposed for the soil gas anomaly detected near the railroad tracks. This decision was based on the following reasons:

- small size of the potential contamination;
- lower concentrations;
- no visible ground stain; and
- information gained from the borings in the other plumes can be used to estimate the depth and analytes present for this plume.

Number of Borings	Total Depth	Number of Samples
2	18	10

Samples will be analyzed using the following methods:

0-1 foot	Semivolatiles
4-5 foot	Volatiles, Semivolatiles
9-10 foot	Volatiles, Semivolatiles
14-15 foot	Volatiles, Semivolatiles
17-18 foot	Volatiles, semivolatiles

0210v
Rev. 7/28/87

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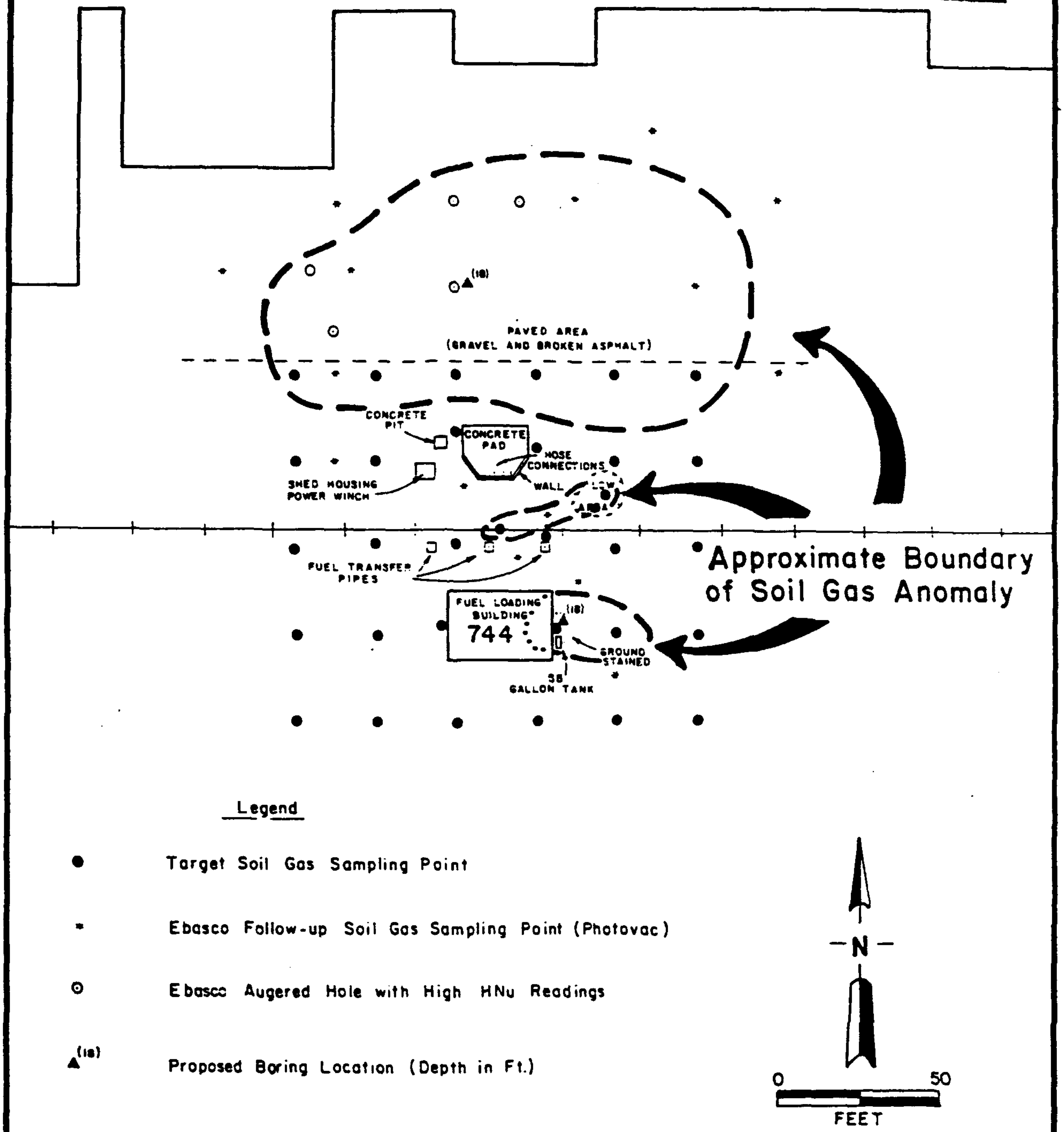
PREPARED IN SUPPORT OF LITIGATION



Prepared for: Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	**FIGURE 1** **Sample Station Locations** **Spill Site 9** Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated

Letter Technical Plan
Task 24 - Rocky Mountain Arsenal
Army Spill Site #18

Background

Army spill Site #18 (Task 24 Technical Plan - Vol. I) is located in the area surrounding maintenance buildings 543, 543B, 544, and 545. No locations of spills were given in the literature so an initial soil gas screening study was conducted in order to help delineate contaminated areas and to direct the placement of soil borings, if needed. Target environmental services provided field and analytical support for the study outlined in the Task 24 technical plan (Ebasco 1987). All sample points were analyzed for aromatic and aliphatic hydrocarbons and methyl ethyl ketone. One third of the sample points were additionally analyzed for chlorinated hydrocarbons. All the samples analyzed for chlorinated hydrocarbons contained detectable levels of contaminants. This raised a question because information from these detections was not sufficient to determine if the contamination was unique to the site or due to background levels present in South Plants. Another question was raised by detections of Benzene and Methyl Ethyl Ketone north of Building 545. These detections seemed to indicate a possible source area outside of the original sample grid.

In order to address the 2 questions raised by the Target results, additional follow up sampling was required. Ebasco has newly developed in house soil gas capabilities which were considered less expensive than additional Target sampling. Thus, Ebasco conducted the follow up work that has shown that the chlorinated hydrocarbon contamination detected by Target appears to be unique to the site, and also has discovered the source area for the contamination detected north of Building 545. The soil gas screening has shown where contaminated soil is likely to exist and has resulted in the location of 1 proposed additional boring.

Results of Soil Gas Screening

Results from the follow up study confirmed an apparent zone of contamination around the west loading dock of Building 543 (Fig. 2). Also, very localized hits were encountered along the railroad tracks south of 543. Additionally, contamination originally detected in the gravelled yard north of Building 545 by Target was further tracked by Ebasco to a small trench which drains east into a culvert, under the road, and into an east-west ditch (Fig. 2). Soil gas contaminant levels in this trench were greater than 3500 ppm for benzene and off scale for unknowns. High HNU readings were also recorded.

Proposed Soil Sampling

A soil boring has already been drilled in the believed source area of soil gas contamination detected at the west loading dock of Building 543. This boring was drilled per Task 24 Tech Plan Vol. I due to ground staining noted by Ebasco field reconnaissance. No additional borings are proposed for this area. Localized soil gas hits along the railroad tracks are believed to be the result of small incidences such as dripping railcars and are not believed sufficient enough to warrant drilling.

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Rev. 7/28/87

In the small trench approximately 100 ft north and 50 ft east of Building 545, where high levels of contaminated soil gas were detected, one soil boring is proposed. This boring will be drilled to groundwater and will be analyzed for the standard suite of Phase I analytes. Samples will be taken from the standard intervals plus the one foot interval immediately above groundwater. Information gathered from this boring will be used to confirm the analytes detected by the soil gas study, and to interpret the vertical extent to which this contamination exists.

Number of Borings	Total depth (ft)	Number of Samples	Analytes
1	18	5	Phase I Analytes

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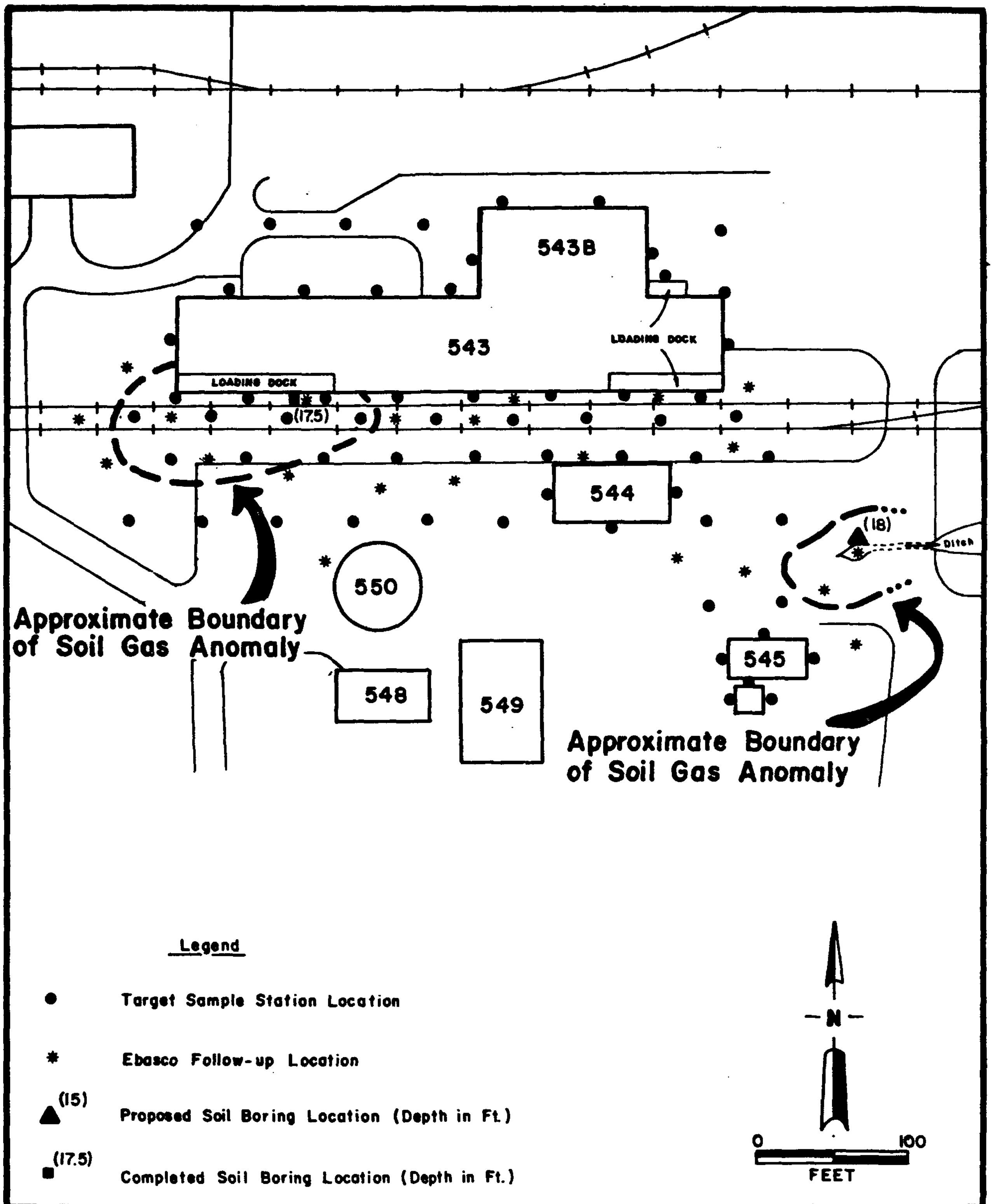
Rev. 7/28/87



Prepared for:	FIGURE 2
Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	Sample Station Locations Spill Site 18 Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated

EBASCO SERVICES INCORPORATED EBASCO

143 Union Boulevard, Suite 1010, Lakewood, CO 80228-1824, (303) 988-2202

August 7, 1987
RMA24-EDEN-USAT-015

Commander, Office of the Program Manager
for Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE/D. Borrelli
Building E4460
Aberdeen Proving Ground
Maryland 21010-5401

Subject: Revisions to Letter Tech Plan for Task 24, Army Spill Sites 9 and 18

Dear Darryl:

As we discussed in the telephone conversation on August 5 among you, Brian Myller and myself, we are moving the proposed boring location for Site 9 to a spot just south of the paved area. The new location is shown on the attached Figure, which should replace the current Figure 1 in the July 28, 1987 Letter Tech Plan.

Since you have approved the drilling plan for these sites with this change, we have scheduled rigs for Monday, August 11. When these two sites are drilled, the Task 24 drilling program will be completed.

Sincerely,

Penelope L. Niland

Penelope L. Niland
Manager, Task 24

PLN:bjs

Attachment

cc: D. Campbell
K. Blose
P. Chiaro
J. Keithley
K. Knirsch
B. Myller - Stollar & Associates
DCC/Denver
DCC/Santa Ana
Chron File

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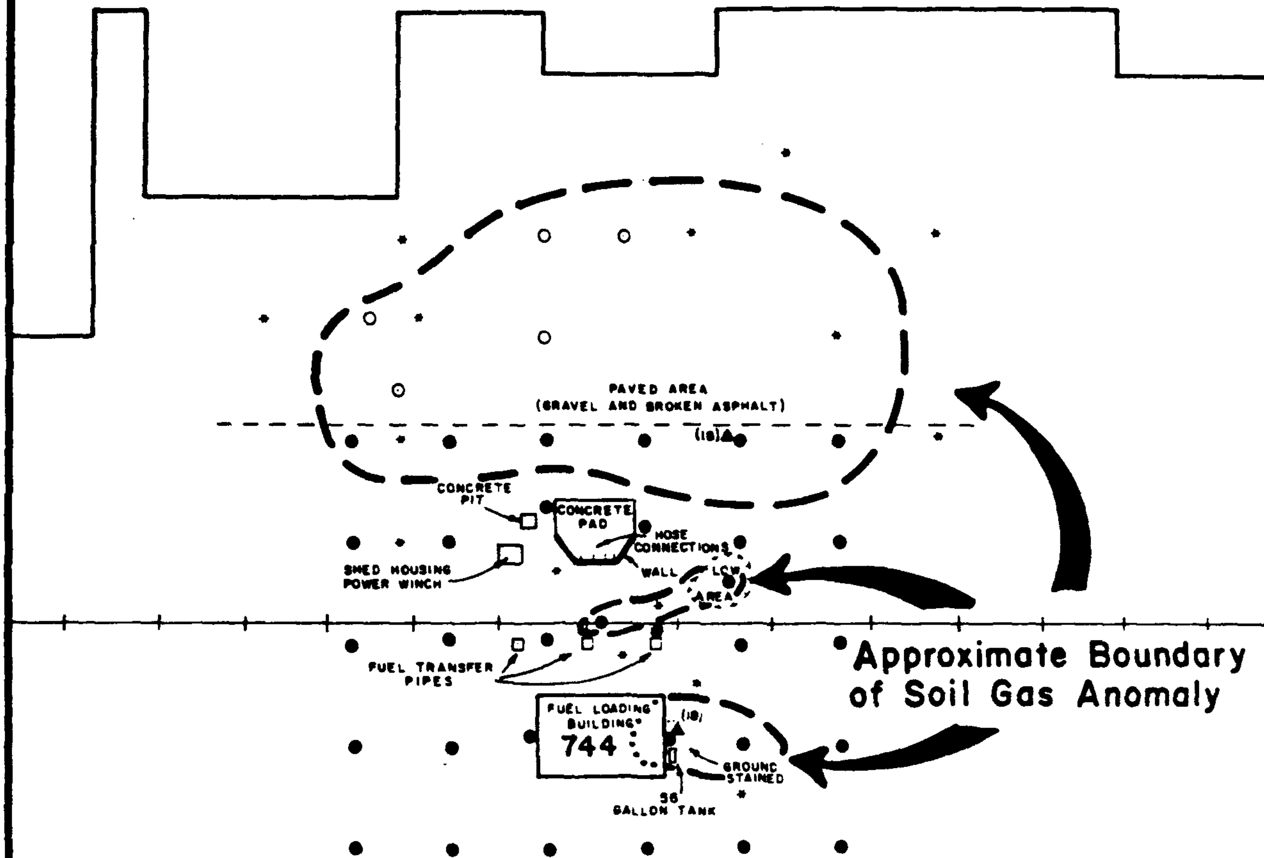
Rev. 8/7/87

PRIVILEGED INFORMATION
PREPARED IN SUPPORT OF LITIGATION



Legend

- ● Target Soil Gas Sampling Point
- * Ebasco Follow-up Soil Gas Sampling Point (Photovac)
- ⊙ Ebasco Augered Hole with High HNu Readings
- ▲(18) Proposed Boring Location (Depth in Ft.)

Prepared for:	FIGURE 1
Program Manager's Office for Rocky Mountain Arsenal Cleanup Aberdeen Proving Ground, Maryland	Sample Station Locations Spill Site 9 Rocky Mountain Arsenal, Task 24 Prepared by: Ebasco Services Incorporated

Volume I

Appendix 24-D

MOA Party Comments

on Draft Technical Plan

Memorandum of Agreement (MOA) general comments on this Technical Plan were discussed in an MOA meeting of February 18, 1987. A detailed discussion of these comments are contained in the minutes of this meeting. EPA verbal comments have been incorporated in the content of the Final Technical Plan. Specific written comments by MOA parties along with the written responses are included in this appendix..

STATE OF COLORADO

COLORADO DEPARTMENT OF HEALTH
4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 320-8333

Roy Romer
Governor

Thomas M. Vernon, M.D.
Executive Director

March 16, 1987

Mr. Kevin Blose
Office of the Program Manager
RMA Contamination Cleanup
Department of the Army
AMXRM-EE, Bldg. 4585
Aberdeen Proving Ground, Maryland 21010-5401

RE: South Plants Soils Remedial Investigations

Dear Kevin:

Enclosed are the State's comments on the Draft Phase I Contamination Assessment Report (CAR) for sites 1-13 and 2-18; the Task 24 Draft Technical Plans Volumes I and II, for Army Spill Sites; and the Task 2 Letter Technical Plan for the South Plants Regional Study. These reports are interrelated and therefore, at your request, we have delayed our review in order to comment on the four reports at the same time.

Our principal concerns with the reports are that the representation of the extent of contamination in the CAR is severely underestimated, and that the implementation of the other Phase I plans as proposed will not adequately define the nature and extent of contamination in the soils at the South Plants. The plans should be modified to define the nature and extent of soils contamination in the South Plants and to be consistent with the requirements of the National Contingency Plan for the conduct of remedial investigations.

If you have any questions, please contact Mr. Chris Sutton with this division.

Sincerely,

Mary J. Gearhart

Mary J. Gearhart, P.E.
Section Chief, Permits
Hazardous Materials & Waste
Management Division

MJG:nr

cc: Howard Kenison, Colorado Attorney General's Office
Robert Duprey, U.S. Environmental Protection Agency, Region VIII
Robert Lundahl, Shell Oil Company

87021 1/2

DEPARTMENT OF THE ARMY
PROGRAM MANAGER, ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP
ABERDEEN PROVING GROUND, MARYLAND 21010-5401

REPLY TO
ATTENTION OF

May 12, 1987

Environmental Engineering Division

Mr. Thomas P. Looby
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Looby:

We have reviewed your comments on the Draft Final Task 24 Technical Plan (Volume I -- Army Spills, and Volume II -- Structures), contained in your letter dated March 16, 1987. We understand that you have no specific comments on Volume II -- Structures. Our response to your comments on Volume I -- Army Spills is enclosed.

In general, we are in disagreement with your contetion that the program proposed will not adequately define the nature and extent of contamination caused by Army spills in the South Plants area. Borings and analytes have been proposed utilizing the best available information sources and documentation. We believe that this program in conjunction with other programs conducted in the South Plants area will more than adequately provide areal coverage of the approximately 4,500,000 square feet under study. In total, more than 339 borings have been drilled or proposed within the South Plants area. Estimates for boring density based on the empirical curve as presented in the Task 2 Technical Plan would have recommended the placement of 211 borings for both the Phase I and the Phase II combined. We have exceded this recommendation by over 60% in the Phase I alone.

Furthermore, we believe this program, as with all Remedial Investigation Programs conducted at Rocky Mountain Arsenal, to be consistent with the requirements of the National Contingency Plan. In addition, the U.S. Environmental Protection Agency is in full agreement with our proposed study approach. If you have any questions regarding the attached responses, please contact Mr. Darryl Borrelli at (301) 671-3261.

Sincerely,

Donald L. Campbell

Donald L. Campbell
Litigation Team Member

Enclosure

RESPONSE TO COLORADO DEPARTMENT OF HEALTH COMMENTS
TASK 24 TECHNICAL PLAN, VOULUME I -- ARMY SPILLS
March 16, 1987

GENERAL COMMENTS:

1. Comment:

The Shell spill sites Phase I Contamination Assessment Report (CAR) concluded that historical information was unreliable to define the occurrence, nature, extent, and "responsibility" for spills in the South Plants. Therefore, further spills investigations must not be based solely on the historical information. The Phase I spill sites investigation cannot be limited to placing borings only in "known" spill sites or by analyzing only those compounds the Army suspects were spilled in a specific area. The Task 24 sampling and analytical protocols must be identical with Task 2 investigations if a complete investigation is to be conducted. Furthermore, for a correlation of the Task 24 and Task 2 data to be valid, the sampling and analytical protocols for the Tasks must be identical.

Response:

Further spills investigations are not based solely on historical information. Field reconnaissance and conversations with present or former Arsenal personnel were also utilized to aid in locating spills and determining where borings should be placed. The Army spill sites investigation is limited to areas where the Army suspects that spills occurred; however, the Task 24 drilling program is designed to supplement prior drilling and analytical programs (such as Task 2) and to complement concurrent drilling and analytical programs (such as South Plants Regional Study). As is explained in the Task 24 Technical Plan (Volume I -- Spills), borings at each site will be sampled and analyzed for the standard Phase I suite of analytes as well as for specific Army compounds if coverage has not been or will not be provided for the same area under other tasks. The sampling intervals and analytical methods for these borings are the same as were utilized for Phase I studies under other tasks, supplemented as appropriate with analyses for surety or for Army agent degradation products.

2. Comment:

The third objective of Task 24 is "to assess the nature of contamination in Rocky Mountain Arsenal (RMA) structures." However, no substantive sampling is proposed to achieve this objective. The proposed RMA structure survey is merely an inventory of facilities and structures. The third objective should be restated to read "a preliminary classification of structures as suspected contaminated or uncontaminated" will be made based on the available historical information and the best judgment of PMO.

Response:

The method for assessing the nature of contamination in RMA structures is discussed in detail in the Task 24 Technical Plan (Volume II -- Structures). This method was considered to be the most effective based on cost and the nature of information necessary at this stage of the Remedial Investigation/ Feasibility Study Process. As a summary statement, the third objective is an accurate statement of the Task 24 objectives related to the RMA structures.

3. Comment:

The Task 24 Technical Plan proposed an insufficient number of borings and an inadequate depth of soil sampling to define the nature and extent of contamination. The Shell Spill Sites Contamination Assessment Report showed substantial deep contamination. According to the PMO, the water table in the South Plants has been steadily dropping. Therefore, the proposal to identify only the unsaturated zone contamination will result in an incomplete definition of the vertical contamination and may severely underestimate the volume of soils requiring remediation.

Response:

At most sites where drilling will be done under Task 24, at least one boring will be drilled to the water table. The exception to this general rule is in instances where the alleged spill occurred to the surface of the ground and where the location and extent of the spill is not well defined. In these instances, shallow bores may be placed as a screening mechanism to attempt to locate the spill.

As stated at several locations within the Task 24 Technical Plan, anticipated depths from ground surface to the water table are provided so that the appropriate number of samples and planned sampling intervals can be identified. If the water table is not encountered at exactly the anticipated depth, the boring will be taken to the water table regardless of the planned depth stated in the Technical Plan. Planned depths are provided so that resources (such as lab capacity and drilling schedules) can be allocated; they are not a limiting factor on the total drilling depth in instances where drilling to the water table is specified.

SPECIFIC COMMENTS:

1. Comment:

Page 1-1: Please explain why the Phase I Army spill sites investigations are being conducted almost 2 years after the Shell Spill Sites Investigations (1-13 and 2-18); have different objectives and criteria (number of borings, sample depths, etc.); and cover essentially the same areas of Section 1 as the Shell Spill Sites.

We do not concur with the representation that spill sites can be separated as "Shell Spills" and "Army Spills". The identification of spill responsibility may or may not be possible after collection and review of all data. All Phase I and Phase II investigations should be characterized as South Plants spills investigations and sampling. Analytical protocol must not vary with the presumed spill responsibility.

Response:

The Army Spill Sites Investigation is being conducted at a later date than the Shell Spill Sites Investigation because it is not possible to drill every site simultaneously; work must be scheduled and a pace established that is not inconsistent with laboratory capacity, sample holding times, and similar constraints. In addition, work at the Army spills was scheduled later to allow time for the certification of laboratory methods for Army agent degradation products.

As stated in Section 1 of the Technical Plan, the drilling programs that have been or are being conducted in the South Plants Area are designed to be complementary. The drilling programs were planned to assure that: 1) complete coverage would be obtained over the entire South Plants Area; and 2) that duplicative boring and sampling would not be done (e.g., if borings done under the Shell Spill Sites Study fell within or near areas identified for drilling as a part of the Army Spill Sites Study and were sampled for the same analytes, borings for those analytes would not also be done under the Army Spill Sites Study).

The Shell Spill Sites and Army Spill Sites Studies are both more focused than the general South Plants Regional Study; borings were located in areas where historical research or field reconnaissance indicated that substance may have been spilled, rather than on a rigidly defined grid. Again, the work was divided into discrete sections on the basis of historical use/spill information, as it is not possible to proceed on all sites simultaneously. Ultimate responsibility for a spill in a given instance has not yet been assigned.

As explained in the Task 24 Technical Plan (Volume I -- Spills), borings at each site will be sampled and analyzed for the standard Phase I suite of analytes as well as for specific Army compounds if coverage has not been or will not be provided for the same area under other tasks. The sampling intervals and analytical methods for these borings are the same as were utilized for Phase I studies under other tasks, supplemented as appropriate with analyses for surety or for Army agent degradation products.

2. Comment:

Page 1-6: The sampling protocol proposed for non-volatile compounds (composite sampling from shallow trenches) are substantially different than any previously used soil sampling method. Please explain why the changes are proposed and how this will affect the ability to correlate the data collected in the soil boring program.

Response:

A trenching procedure (in lieu of augering) is proposed to obtain shallow (6 inch depth) soil samples in an area that was once beneath overhead transfer lines at Spill Site 40 to investigate possible contamination that may have been caused by leaks of distilled mustard from an overhead transfer line.

Also see the discussion on page 3-77, which explains the sampling rationale at Spill Site Number 40. A boring to the water table (anticipated to be at 10 feet at this location) is planned for the site; all intervals from that boring will be sampled and analyzed for the standard suite of Phase I analytes and for thiodiglycol. The boring has been placed at a location where the mustard transfer lines (no longer in existence) made a 90-degree bend, as it is thought that this location had the highest potential for leaks.

Additional drilled borings or hand-augered bores at this site are infeasible because of access problems related to utilities, pipelines, and paving within the potential spill area. Again, because of access difficulties, the trenching is limited to hand-trenching in these locations. A single composite will be prepared from each of the three trenches, and the composite from each trench will be analyzed for thiodiglycol in an attempt to better determine if, and where, leaks may have occurred. The size of the trench was chosen to maximize the possibility that any leaks from the former transfer lines would be detected, as the exact location of the lines (and consequently any leaks from the lines) is not descernible onsite. The 6-inch depth was chosen because the leaks reportedly occurred from overhead lines, and any substances leaking from the lines would have fallen on the surface of the soils. Mustard hydrolizes rapidly to thiodiglycol and associated products if it comes into contact with water, so analysis for thiodiglycol will indicate whether mustard may have leaked onto the soil. It is unlikely that soil accretion at this location has exceeded 6 inches in the past 40 years, so the mustard degradation products, if present at all, may be detectable in the uppermost 6 inches of the soil column.

If the trench composites indicate that leakage from the old transfer lines did occur additional borings or hand-augered borings will be placed to the maximum extent practicable given access problems at the site, to further define the nature and extent of any soil contamination that may have resulted from the leakage. This information, as well as the information developed from the currently planned boring at the site and the trench composites, will be analyzed and presented in the Contamination Assessment Report for the South Plants.

3. Comment:

Page 1-6: All Phase I analytes (including the non-target GC/MS scan) must be evaluated in all borings at the Army Spill Sites.

Response:

See the detailed sampling and analyses plans for each spill site located in Section 3 of the Techncial Plan. Phase I analytes are specified for at least one boring at sites being drilled under the Army Spill Sites drilling program in instances where adequate coverage has not already been obtained or is not proposed under one or more other tasks. In instances where Phase I analytes are specified, a GC/MS scan for nontarget analytes will be done for the volatile and semivolatile organics, consistent with procedures used for Task 2 Phase I analyses. In instances where only Army degradation products are specified for analysis, a GC/MS scan for nontarget compounds will not be done.

4. Comment:

Page 1-6: Unless Phase II investigations will be conducted, all 210 borings should be completed in the Phase I South Plants Regional Study. More specific analytical methods must be utilized in Phase I of the South Plant investigations if no Phase II efforts are to be conducted.

Response:

Currently, a Phase II is not anticipated under Task 24. The Task 24 drilling program is designed to supplement existing and other planned drilling programs, and is not a typical Phase I drilling program. As stated in Section 1.2.4 on page 1-6, based upon the number of bores and samples being analyzed under various tasks and studies, it appears that adequate coverage will be obtained within the South Plants Area without Phase II drilling. However, if the results of the Task 24 drilling and sampling program indicate that coverage is not adequate, or that there is a need for further study, the Phase I results will be utilized to develop a Phase II program. As stated in the text, if such a program is necessary, it will be a part of a subsequent task, and not a part of Task 24.

5. Comment:

Page 3-2: Given an areal extent of Spill Site number 1, the suspicion that the Army and Shell have spilled chemicals at the site, and the 1-13 CAR finding that several unknowns were found in the surface soils, at least two borings should be constructed in this location with one extending into the water table.

Response:

As stated in the text on page 3-2, a Task 2 boring was drilled at this location, and no target volatile or semivolatile analytes were detected. Given the speculative nature of the location of the spill and the previous drilling done in the area, no additional drilling and sampling is warranted.

6. Comment:

Page 3-8: The text should note that mercury contamination was identified in many of the borings surrounding Building 512. Therefore, additional Phase I borings should be constructed in this location with one extending into the water table.

Response:

As five Phase I borings have already been drilled within the boundary of possible Army Spill Site Number 4, and as an additional boring is proposed as part of the South Plants Regional Study, adequate coverage for the area has been obtained, and additional borings are not warranted.

7. Comment:

Page 3-10: Spill Site Number 5. Given the areal extent of this spill, three, five-foot borings are insufficient to characterize the extent of contamination. Task 2 borings in this area showed elevated concentration of many compounds distributed laterally and vertically, including dieldrin, aldrin, isodrin, DCPD, MIBK, CPMSO, arsenic, mercury, and others. Therefore, several more borings extending into the water table are needed to evaluate the area within the defined boundaries of the spill area.

Response:

As shown on Figure 24-6, a total of 18 borings have been drilled or are proposed for drilling within the boundary of possible Army Spill Site Number 5. Information from all drilling programs will be utilized to evaluate the nature and extent of contamination within the potential site boundaries. As pointed out in the above comment, samples from these bores have indicated the presence of several substances. There has been adequate coverage of the area, and additional Phase I borings are not warranted.

8. Comment:

Page 3-13: Spill Site Number 6. To comply with the sampling protocol described, the borings must extend to the water table (anticipated to be at 20 feet below the surface).

Response:

As the nature and exact location of any lewisite contamination is not known, and as any such contamination would likely have resulted from surface spills, the planned five-foot bores are adequate to locate this possible spill with greater specificity. As several other borings have been placed in this area, coverage is adequate, and deeper bores are not justified at this time.

9. Comment:

Page 3-15: Spill Site Number 7. The soil samples proposed must be analyzed for all Phase I analytes.

Response:

There are several other borings in the area that have been or are proposed for analysis of Phase I analytes. As the borings in possible Spill Site Number 7 have been placed for the specific purpose of determining whether mustard was spilled, and as other borings have provided or will provide adequate coverage for Phase I analytes, analysis of the Spill Site Number 7 borings (16 and 17) for Phase I analytes (volatiles and semivolatiles) is not necessary. However, as stated in the text, samples from these borings will be analyzed for inorganic mercury and arsenic, in addition to analysis for thiodiglycol and chloroacetic acid, to determine whether lewisite related contamination may have occurred in the area.

10. Comment:

Page 3-18: Spill Site Number 8. The soil samples proposed must be analyzed for all Phase I analytes.

Response:

There are several other borings in the area that have been or are proposed for analysis of Phase I analytes. As the boring in possible Spill Site Number 8 has been placed for the specific purpose of determining whether mustard was spilled, and as other borings have provided adequate coverage for Phase I analytes, analysis of the Spill Site Number 8 boring (boring Number 9) for Phase I analytes (volatiles and semivolatiles) is not necessary.

11. Comment:

Page 3-19: Spill Site Number 9. The proposed program does not address the potential non-volatile and inorganic contamination that may be present in the soils. Some borings should be constructed in Phase I of Task 24.

Response:

As stated in the last paragraph on page 3-19, the purpose of the soil gas screening at this site is to provide more information for the placement of borings, since the exact location and nature of the spills is not well identified. Once the results of the soil gas sampling are obtained and analyzed, soil borings may be proposed as appropriate to characterize the nature and extent of soil contamination at the site.

12. Comment:

Page 3-21: Spill Site Number 10. At least one Phase I boring must extend to the water table.

Response:

No references were found indicating that any substances stored in Building 753 were spilled. Thus, the two borings planned for Spill Site Number 10 have been placed in locations, based upon field reconnaissance, where any substances that may have been spilled would be most likely to be found. One boring has been placed in a low spot north of Building 753; if spills did occur in and around the building, runoff from the area would have collected in this area. Another boring has been placed in a fenced area east of the building to determine whether the fenced area was utilized for storage, and, if so, if spills occurred in this area. As any spills in the area would have been to the surface, any substances detectable in the soils in the area would be most likely to be found in the upper portion of the soil column, so five-foot bores and sampling intervals would be the most likely to detect any spilled substances if such substances are present.

13. Comment:

Page 3-14: Spill Site Number 12. Two borings are insufficient to characterize the extent of contamination over this designated spill area. Considering the very high levels of contaminants found in nearby borings in Task 2, the boundaries of the spill site should be extended northward and additional borings should be constructed to characterize the vertical and lateral extent of contamination.

Response:

As stated in the text on page 3-24, the areas of interest at this possible spill site are the pits which were used for disposal of lime sludge from the acetylene generators. One boring has been located within each of the two pits. Both borings will be taken to water (anticipated to be 20 feet below the ground surface at this location). Placement of additional borings at the site would not yield additional information about the contents of the pits, so placement of additional borings is not warranted at this time.

14. Comment:

Page 3-26: Spill Site Number 13. The soil samples proposed must be analyzed for all Phase I analytes.

Response:

As stated in the text on page 3-26, the substance allegedly spilled in this area was arsenic trioxide dust. Therefore, the borings will be sampled and analyzed for inorganic arsenic, and will also be analyzed for lewisite and lewisite oxide by the RMA laboratory. In addition, one of the four borings proposed for this site will be analyzed for the standard suite of Phase I analytes, as is explained in the text on page 3-27. As there are several other existing or proposed borings in the area that have been or will be analyzed for the standard suite of Phase I analytes, analysis of all four borings for Phase I analytes is not warranted.

15. Comment:

Page 3-29: Spill Site Number 14. Task 2 identified some of the highest levels of contamination found in RMA soils within this area. The proposal for Task 24 investigations must include additional borings in order to define the nature and extent of contamination within the designated spill area. All Phase I analytes must be run in the soil samples collected.

Response:

As stated in the text on page 3-29, the purpose of the drilling and sampling at this potential spill site is to investigate possible mustard contamination associated with the neutralizing and disposal facilites for "wild" (incompletely neutralized) batches of mustard. Therefore, borings at the site have been placed within areas where physical remnants of these facilities can be seen, and samples from the borings will be analyzed for thiodiglycol and chloroacetic acid which are mustard breakdown products. Information gathered from the Task 24 borings will supplement information already available (as noted in the above comment) from previous drilling programs. Phase I analytes are proposed as analytes in one boring (proposed to be drilled to water table) in each of the east and west segments of this site.

16. Comment:

Page 3-35: Spill Site Number 16. At least 2 additional borings should be constructed to define contamination within a lineal feature such as a ditch.

Response:

Two borings are proposed for Spill Site Number 17. Army Spill Site Number 17 lies just to the north of Spill Site Number 16, and encompasses a portion of the same ditch system. Thus, for the ditch system as a whole, three borings are proposed under Task 24.

17. Comment:

Page 3-44: Spill Site Number 19. Additional borings are needed to evaluate a spill area of this size. A minimum of two more borings are needed in the "low spot" where a spill may have accumulated.

Response:

As stated in the text on page 3-44, the exact nature, location, and dates of spills that may have occurred relative to the heavy industrial equipment renovation facilities in Building 751 are not known. However, a field reconnaissance of this area indicated that there are trench drains within the building that drain to the east end of the building, where there is a vitreous clay pipe drain through the wall of the building. The drain through the wall was once connected to a vitreous clay pipe that carried any drainage away from the immediate vicinity of the building and emptied into a low spot between the railroad tracks south of Building 751. The drainpipe is now broken, and any liquid accumulating in the trench drains inside the buildings now drains onto the ground on the east side of Building 751. As indicated on Figure 24-19, there is a visible stain and stressed vegetation in the area where the pipe now apparently discharges. It is not known when the break in the drainpipe occurred.

As the purpose of the drilling at this site is to locate and better define the nature of any spills that may have occurred, one boring is proposed for the stained area exhibiting stressed vegetation, and another boring is proposed for the former outfall area of the now broken pipe. One boring is proposed to the water table, and the other five feet above the water table. Both borings are located at likely discharge points for the standard suite of Phase I analytes. As this provides adequate coverage of the areas where any substances that may have been spilled would most likely be detected, additional borings at this site are not necessary.

18. Comment:

Page 3-47: Spill Site Number 20. Task 2 boring N101 was constructed 4 feet deep and showed dithiane (10ppm), dieldrin (1ppm), and very high levels of metals, including mercury at 110ppm. Boring N101 should be triangulated. More borings within the ditch are necessary to define the nature and extent of contamination.

Response:

As stated in the text on page 3-47, the purpose of the Task 24 drilling at this site is to determine the nature of the liquid that was observed trickling from a tank east of Building 536 in 1981 (and any resulting soil contamination). The information gathered as a part of the Task 24 drilling program will be utilized to supplement existing information on potential comtamination in the vicinty of the site; as is acknowledged in the above comment, information is already available from previous studies. Boring N101 was done as a part of the Shell Spill Sites Investigation, and any triangulation or additional definition of contamination detected in that boring will be considered as a part of any planned Phase II activities for the South Plants Area.

19. Comment:

Page 3-52: Spill Site Number 24. There were no Task 2 borings within the defined spill area. The nearest Task 2 borings showed elevated mercury. Task 24 borings should be constructed to the water table and analyzed for the complete Phase I analyte list.

Response:

As stated in the text on page 3-52, several borings have been placed in the vicinity of possible Spill Site Number 24. As the above comment acknowledges, information is available from those borings. The Task 24 borings are designed to supplement drilling programs that have been completed or are proposed as a part of other tasks, and as coverage in this area is adequate, no additional borings are warranted under Task 24.

20. Comment:

Page 3-54: Spill Site Number 25. The number of borings is insufficient to define the extent of contamination within the ditches and in the designated spill area.

Response:

The purpose of the drilling program at Spill Site Number 25, as stated in the text on page 3-54, is to determine whether the ditches may have received process wastewaters. A total of three borings are planned for the ditch system. This number of borings provides adequate coverage for this area, and additional borings are not warranted.

21. Comment:

Page 3-57: Spill Site Number 26. There were no Task 2 Borings within this spill area. At least 1 soil boring should be constructed to the water table in this area and analyzed for the complete Phase I analyte list.

Response:

As stated in the text on page 3-57, Buildings 331 and 332 were once part of the phosgene complex. Liquid wastes from these buildings (331 and 332) were discharged to the chemical sewer, and fumes were vented through caustic scrubbing towers. Phosgene is a gas, so if there were leaks of the gas, it is unlikely that any such leaks would be detected through a soils boring program. As there are four South Plants Regional Study bores proposed for this area, and as these four bores will provide adequate coverage, borings are not warranted under Task 24. As stated above, the Task 24 drilling program is designed to supplement existing or proposed borings under other tasks, and duplicative boring and sampling will not be proposed under Task 24 if adequate coverage is provided by one or a combination other tasks.

22. Comment:

Page 3-58: Where do the floor drains of Buildings 362 and 365 discharge?

Response:

The discharge from the drains will be determined as a part of the structures survey (see the Task 24 Technical Plan, Volume II -- Structures). If the drains are tied to one or more of the sewer systems in the area, any contamination of the sewer systems will be discussed as a part of the studies being conducted under Task 10.

23. Comment:

Page 3-59: Spill Site Number 28. There were no Task 2 borings within this spill area. At least (sic) 1 soil boring should be constructed to the water table in this area and analyzed for the complete Phase I analyte list.

Response:

Two South Plants Regional Study borings are proposed for the immediate vicinity of Buildings 362 and 365; one (at the northwestern corner of the building complex) is proposed to be drilled to the water table. In addition, eight Task 2 Phase II borings are proposed immediately to the east of this building complex. As this provides adequate coverage for the area, no additional bores are proposed as a part of Task 24.

24. Comment:

Page 3-62: Spill Site Number 30. There were no Task 2 borings within this spill area. At least 1 soil boring should be constructed to the water table in this area and analyzed for the complete Phase I analyte list.

Response:

As stated in the text on page 3-62, the spill that allegedly occurred here was of chlorine, and the chlorine was reportedly in gaseous form. Thus, a soil boring program is unlikely to detect any evidence of such a spill. Six Task 2 Phase I borings were drilled in the tank storage area immediately to the north and west of the possible spill area. In addition, two South Plants Regional Study bores are proposed in the vicinity of this potential spill; one is located between buildings 251 and 321, along the railroad tracks. As this provides adequate coverage for the area, no additional bores are warranted under Task 24.

25. Comment:

Page 3-76: Spill Site Number 37. Two borings are insufficient to define the extent and nature of contamination in the designated spill area. Borings closer to Building 742 and in the ditch should be collected.

Response:

The drilling program for the area near Building 742 is discussed on pages 3-71 and 3-72. Borings placed closer to Building 742 are not likely to provide useful results, as the drainage from the building is conveyed in a concrete culvert at that point (as is shown on Figure 24-26). Therefore, borings are proposed at the point where the drainage enters the culvert (boring number 41) and exits from the culvert to the ditch (boring number 42). As these borings have been placed in the locations where evidence of the spills, if any exists, is most likely to be found, placement of a greater number of borings will not provide any more useful information than will be gained from the two planned borings. Therefore, additional borings are not warranted.

26. Comment:

Page 2-76 (sic): Spill Site Number 30. All Task 2 borings in the northern vicinity of Building 537 show elevated mercury (bores J601, J902, T201, U101). The extent of mercury contamination (and all other Phase I analytes) in the soils north of Building 537 should be defined in Task 24.

Response:

As stated in the text on page 3-76, the mercury catalyst was apparently spilled within Building 537; evidence of contamination within the building will be researched as a part of the structures survey (see the Task 24 Technical Plan, Volume II -- Structures). As pointed out in the above comment, information is already available from previous drilling programs regarding potential mercury contamination in the vicinity of Building 537. Since the Task 24 drillling program is planned to supplement, and not duplicate, previous or planned drilling programs under other tasks, there is no need to plan duplicative borings at this site under Task 24.

Shell Oil Company

One Shell Plaza
P.O. Box 4320
Houston, Texas 77210

February 16, 1987

USATHAMA
Office of the Program Manager
Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE: Chief: Mr. Donald L. Campbell
Bldg E4585, Trailer
Aberdeen Proving Ground, MD 21010-5401

Dear Mr. Campbell:

Enclosed herewith are Shell's comments on Task 24, Volume I, Phase I Program for Army Spill Sites, January 1987.

As discussed under General Comments, Shell's major concern with this proposed Phase I investigation is the Army's intention to proceed with the investigation before completion of research and evaluation of background information on Army spills and before completion of the full set of certifications of analytical methods for Army surety degradation products.

In Shell's opinion, proceeding with the proposed program before completion of these essential RI elements will result in a work product of little or no value to the RI/FS process. Shell recommends that these elements be completed before initiating the Task 24 field investigations.

Very truly yours,

R D Lundahl

for C. K. Hahn
Manager
Denver Site Project

RDL:ajg

Enclosure

BRHM8701202

cc: (w/enclosure)
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DEPARTMENT OF THE ARMY
PROGRAM MANAGER, ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP
ABERDEEN PROVING GROUND, MARYLAND 21010-5401

REPLY TO
ATTENTION OF

May 4, 1987

Environmental Engineering Division

Mr. Chris Hahn
Shell Oil Company
c/o Holme Roberts and Owen
1700 Broadway
Suite 1800
Denver, Colorado 80290

Dear Mr. Hahn:

We have reviewed your comments on the "brown cover" Task 24 Technical Plan (Volume I -- Army Spills), contained in your letter dated February 16, 1987. Our responses to your comments are enclosed.

Your concern with our intention of proceeding with field efforts before all background information has been evaluated is unfounded. We have evaluated all available information on a site-by-site basis and proceeded with drilling and sampling upon completion of research on each site. Currently, initial research has been completed on all identified sites. However, as additional information becomes available through personnel interviews or other sources, we re-evaluate our program. At this time, methods for agent degradations products have been certified and are included in the parameters list for chemical analysis of the relevant samples. Further discussion of this issue will follow shortly in our letter discussing your concerns on chemistry issues. We believe our approach be consistent with intent of the National Contingency Plan and essential to the Remedial Investigation/Feasibility Study process for Rocky Mountain Arsenal.

If your have any questions regarding these responses, please contact Mr. Darryl Borrelli, (301) 671-3261.

Sincerely,

Donald L. Campbell
Litigation Team Member

Enclosure

COMMENTS ON TASK 24 TECHNICAL PLAN
VOLUME 1--ARMY SPILLS ("BROWN COVER")
GENERAL COMMENTS

1. COMMENT:

The text states (at page 1-3) that the boring density for Army spill sites is based on the South Plants Regional Study grid which was developed using the empirical bore spacing curve (Figure 24-1) and an "unexamined area" of 4,500,000 square feet. Shell's comments on the South Plants Regional Study boring strategy (see specific comment number 4 in the enclosure to our December 22, 1986 letter) apply as well to the Army spill site boring strategy.

> (Specific Comment Number 4, December 22, 1986 letter, referring to the South Plants Regional Study Technical Plan): Introduction - The second paragraph of the introduction indicates that the boundaries of previously identified contamination sources are shown on Figure 1. They are not on the figure indicated. In addition, the area under investigation in the South Plants totals about 4,500,000 square feet. The implication is that the size of the drilling program, including the number of "regional study" borings planned, is based upon this figure. Since the "regional study" area encompasses multiple source areas, Shell believes it would be appropriate to relate the number of borings in a given source area to the historic/suspected activity in the area. The number of borings should be based on the more limited geographic boundary of the site, and not on the 4,500,000 square foot area. This would be more consistent with other Army site investigations.

Specifically, Shell's position is that where potential spill sites are identified, the boring strategy should be based on a site by site analyses (sic) of the boring requirements to test for contamination and to define site boundaries. The strategy for Army spill sites should not be based on a premise that activity in this task area is unknown as is implied by the use of the empirical curve.

RESPONSE:

As stated in the first paragraph on page 1-3, the boring density was originally planned in context with the South Plants Regional Study. As the two studies are complementary, the empirical boring density determination was used as a starting point to assure that: (1) complete coverage at the stated density would be obtained over the entire South Plants area; and (2) that duplicative boring and sampling would not be done (e.g., if borings planned for the regional study fell within or near areas identified for drilling as a part of the Army spill sites study, those borings would be done under one study or the other, but not both).

The discussion on page 1-3 is an attempt to explain this complementary siting process for the borings. As explained in the second paragraph on page 1-3, the use of the grid was a starting point in the planning process; to the extent that the "grid" borings would not fulfill the Task 24 spill sites boring program objectives, other criteria were utilized for locating borings.

Another general criterion utilized to plan boring coverage, locations, and densities was the criterion of at least one boring, but no more than three borings, per spill site. This, again, was a starting point for planning, and not a rigid requirement. As stated in the second paragraph on page 1-3, "... these general criteria were modified as appropriate to provide coverage, coordinate with other Phase I soil boring programs under Task 2 and Task 7, and provide adequate information to meet the overall Army spill sites program objectives." The reader is then referred to the specific discussion of the boring and sampling programs for each individual spill that is contained in Section 3.0 of the Technical Plan. An examination of the individual spill sites discussion in Section 3.0 reveals that, in many cases, these general "starting point" criteria were indeed modified to meet specific site requirements.

2. COMMENT:

Several aspects of the technical plan for this task raise questions as to the thoroughness of the Army's investigations into potential Army spill sites. For example, the primary source document used to determine sites to be investigated in this task is Shell's May 1, 1985 letter. (Twenty nine of the forty one Army spill sites listed in Table 24-1 were identified in Shell's letter). However, Shell's survey was based only on the recollections of Shell personnel and Army documents which Shell had access to. The discussion in 2.1.1 (page 2-1) indicates that this technical plan is based on incomplete review and evaluation of background data. Shell believes that the field investigation should not commence until review and evaluation of all background information sources is complete. Only literature review is mentioned as a source of potential spill site background information. Will the ongoing research utilize other sources of information? This section should list sources of background information which will be used.

RESPONSE:

The literature search conducted prior to preparation of the technical plan indicated that there were 12 additional potential spills, or 40 percent more spills than identified by Shell, requiring discussion or other follow-up in the technical plan. This literature search included the available data bases and the deposition materials, as well as discussions with individuals (see the "References" section of the technical plan). No other indications of Army spills in the South Plants area were found. If Shell is aware of other sources of information, those sources will also be checked, and the informa-tion will be utilized to expand the boring program as appropriate. Research and data/information is an ongoing process, and any new indications of spills discovered during evaluations conducted during the course of the drilling program for Task 24 will also be considered. If the evaluation of the information indicates that an expansion of the boring and sampling program is warranted, the program will be expanded as appropriate.

3. COMMENT:

It is recommended that the sampling and analyses program not commence until the analytical development program is completed. This will avoid the inefficient resampling of these sites at a later date. In addition, we do not agree that the Army should start any Phase II program in any area until all the analytical results and report of the investigation have been reviewed by the MOA parties, and the Army has had an opportunity to review and comment. Shell reserves the right to provide additional comments on this task once we have had an opportunity to review the results of Phase I analyses and reports in adjacent geographic areas to those being proposed for investigation under this task.

RESPONSE:

The analytical development program is discussed in the response to the next comment. As to Phase II, the Army has not commenced any Phase II efforts without review and comment by MOA parties. Of the source areas which were sampled by Ebasco during Phase I activities, as of March 24, 1987, "brown cover" source reports have been transmitted to the MOA parties for 35 of these areas. In addition, the "brown cover" source reports for the Shell spills within the South Plants area (Sites 1-13 and 2-18) were transmitted to the MOA parties for review and comment on January 26, 1987.

4. COMMENT:

At a minimum, certified methods should be developed for the following compounds before commencing analyses of Army spill site samples:

Bis (Carboxymethyl) Sulfone
Thiodiglycol
Thiodiglycolic Acid
Chloroacetic Acid
2-(Diisopropylamino) Ethylsulfonate
Ethyl Methyl Phosphonate
Dimethyl Arsenic Acid
Methyl Arsenic Acid
2-Chlorovinyl Arsenic Acid
2-Chlorovinyl Arsenous Acid
Fluoroacetic Acid
Methyl Phosphonic Acid
Dimethyl Mercury
Methyl Mercury Chloride

RESPONSE:

The first four compounds listed above, bis (carboxymethyl) sulfone, thiodiglycol, thiodiglycolic acid, chloroacetic acid, are mustard breakdown products or substances associated with the production of mustard. The method for thiodiglycol and chloroacetic acid is certified, and will be specified in appropriate circumstances for Task 24 samples. As the presence of thiodiglycol and chloroacetic acid are considered to be reliable indicators of the presence of mustard degradation products, there is no need to analyze for the other two compounds as well. In addition, dithiane and oxathiane are routinely analyzed as part of the semi-volatile fraction. No reliable method for bis (carboxymethyl) sulfone or thiodiglycolic acid have been found by the Army or Shell to date.

2-(diisopropylamino) ethylsulfonate and ethyl methyl phosphate are possible degradation products of VX. As none of the areas being investigated under Task 24 were utilized for VX production or demilitarization and none of the areas involve VX spills, Task 24 samples will not be analyzed for these compounds, so certification of these methods prior to commencement of Task 24 activities is not necessary.

Dimethyl arsenic acid, methyl arsenic acid, 2-chlorovinyl arsenic acid, and 2-chlorovinyl arsenous acid are substances associated with Lewisite production or are potential Lewisite breakdown products. For areas being investigated under Task 24 where Lewisite contamination is suspected, samples will be analyzed for arsenic utilizing the method certified for Phase I, and samples will also be sent to the RMA lab for analysis for Lewisite and Lewisite oxide. No known method exits for the organo-arsenic compounds which is readily available for certification or analysis.

Methyl phosphonic acid is chemically related to DIMP and may be associated with GB manufacture. Fluoroacetic Acid (Fluoroethanoic Acid) is a degradation product of GB. Currently, no analyses for this substance are proposed under Task 24, as none of the spills being investigated under Task 24 are related to GB manufacture. If additional research or information should indicate that analysis for this substance is appropriate under Task 24, the ESE laboratory is certified for this method.

Dimethyl mercury and methyl mercury chloride are possible decomposition products from mercuric chloride used in Lewisite manufacture. As elemental mercury is also a possible decomposition product from mercuric chloride, and as elemental mercury can be detected using the Phase I certified method for mercury, borings where Lewisite or other mercury compound contamination is suspected will be sampled and analyzed for mercury using the Phase I certified method. The only available method for organic mercury, developed by Shell, has a 7 ppm detection level well above the levels of inorganic mercury found in most areas. It is therefore, not reasonable to use this method at this time.

5. COMMENT:

As in the Shell spill site and South Plant Regional Study technical plans, this technical plan expresses an anticipation that a Phase II study may not be required. However, no concise explanation is provided to justify this anticipation nor is there an explanation of what this decision would be based on. It is difficult to understand how Task 2 objectives, i.e., to quantitatively define the nature and extent of contamination, can be met without conducting a Phase II program.

RESPONSE:

Section 1.2.4, page 1-6, states that a Phase II program is currently not anticipated under Task 24, but if the Phase I results indicate a need for further study, a Phase II program will be developed. If a Phase II program is developed, it will be a part of a subsequent task, and not a part of Task 24. This approach is consistent with the approach that has been taken with other tasks, such as Task 7 and Task 12.

COMMENTS ON TASK 24 TECHNICAL PLAN
VOLUME 1--ARMY SPILLS ("BROWN COVER")
SPECIFIC COMMENTS

1. COMMENT:

Page 1-3, second paragraph: Why is the general criterion of one boring, maximum of three, necessary when this criterion is modified to meet the objectives of the task, i.e., to provide coverage and adequate information on Army spill sites?

RESPONSE:

As stated above in the response to general comments, the criterion of at least one boring, but no more than three borings, per spill site was utilized as a starting point in planning and locating the Task 24 borings, and was not a rigid requirement. This criterion was utilized to provide the task planner with some basic guidance as to the scope and intensity of the Task 24 drilling program, and also as a means to allow preparation of a preliminary estimate of drilling and analytical needs and cost for the task.

2. COMMENT:

Page 1-5, second paragraph: The statement that metals (equipment) contaminated with mustard cannot be decontaminated and must be abandoned is inconsistent with the Army's leasing of mustard production facilities to Shell. What has been the disposition of mustard-contaminated equipment? If it was buried, will a Remedial Investigation program address this contamination.

RESPONSE:

The second paragraph will be clarified to indicate that onsite decontamination of any mustard-contaminated equipment by contractors is not contemplated; if any contractor equipment such as augers or core barrels comes into contact with mustard, this equipment will not be reused for the Remedial Investigation program, and will be handled and disposed of per Program Manager's Office instructions. As none of the equipment utilized to date has been contaminated with mustard, there has been no disposition or disposal of such equipment. No equipment has been buried.

3. COMMENT:

Page 1-5, third and fourth paragraphs: The plan only explains what will not be done with samples and equipment which register positive for surety agents. What is the intended disposition? Will a quantitative record of surety agent contamination be made?

RESPONSE:

As stated in the last sentence of the third paragraph on page 1-5, if results of the agent screening are positive, the samples and any other equipment that may have come into contact with surety agents will be held pending instructions from PMO regarding its disposition. We are uncertain about what is meant by "quantitative record"; if surety agent is encountered, the information that is gathered during the screening is reported as a concentration, and is entered on the data base. However, no agent has yet been encountered during the boring screening program, so no "quantitative information is currently available on the data base.

4. COMMENT:

Page 1-6, first paragraph: A trenching procedure (in lieu of augering) is proposed to obtain shallow (6 inch depth) soil samples beneath overhead transfer lines. This procedure, which apparently is applied only at Spill Site 40 to investigate possible contamination caused by numerous leaks of distilled mustard from an overhead transfer line, is ill-conceived in this instance. It is unlikely that the 6-inch depth is the only, or even best, interval to sample for remnants of mustard spills which occurred 40 years ago. Why is a 6-inch sampling depth used at this site, whereas degradation products are analyzed at 5-feet intervals to the water table in the South Plants Regional Study? Point samples are collected from the trenches whose length constitutes less that ten percent of the transfer line run length. Compositing three soil samples from each trench for analysis reduces the chances of detection unless a contaminant is present at all three points. It is not clear why a trench twenty feet long is required to obtain three point samples.

In view of the historical record of spills at this site, soil samples should be taken to the water table at depth intervals of five feet and from borings distributed at appropriate density beneath the entire accessible length of transfer line.

RESPONSE:

See the discussion on page 3-77, which explains the sampling rationale at Spill Site number 40. First, a boring to the water table (anticipated to be at 10 feet at this location) is planned for the site; all intervals from that boring will be sampled and analyzed for the standard suite of Phase I analytes and for thiodiglycol and chloroacetic acid. The boring has been placed at a location where the mustard transfer lines (no longer in existence) made a 90-degree bend, as it is thought that this location had the highest potential for leaks.

Additional drilled borings or hand-augered bores at this site are infeasible because of access problems related to utilities, pipelines, and paving within the potential spill area. Again, because of access difficulties, the trenching is limited to hand-trenching in these locations. Compositing of samples from each of the trenches into a single sample is not contemplated; the discussion on page 3-77 clearly states that a single composite will be prepared from each of the three trenches, and that the composite from each trench will be analyzed for thiodiglycol and chloroacetic acid. The size of the trench was chosen to maximize the possibility that any leaks from the former transfer lines would be detected, as the exact location of the lines (and consequently any leaks from the lines) is not discernible onsite. The 6-inch depth was chosen because the leaks reportedly occurred from overhead lines, and any substances leaking from the lines would have fallen on the surface of the soils. It is unlikely that soil accretion at this location has exceeded 6 inches in the past 40 years, so that some indication of mustard degradation products would most likely be found in the uppermost 6 inches of the soil column.

5. COMMENT:

Page 1-6, second paragraph: Dibromochloropropane is a semivolatile, not analyzed separately, according to Table 24-3.

RESPONSE:

Table 24-3 is correct, and the reference to dibromochloropropane as a separate analyte will be removed from this paragraph.

6. COMMENT:

Page 1-6, paragraph 1.2.4: The text should explain what will determine whether a Phase II program will be needed.

RESPONSE:

The text explains that the determination of whether a Phase II program is needed will be based upon an evaluation of the Phase I results, and that the Phase I results will be utilized to design the Phase II program, if necessary.

7. COMMENT:

Table 24-1, Army Spill Site Number 10: Shell believes that Army, not Shell, pesticides were stored in Building 753.

RESPONSE:

Shell's belief is noted.

8. COMMENT:

Page 2-1, paragraph 2.1.1: Are any methods other than literature reviews being utilized to develop details on the Army spills? How will the completed literature review for Task 24 be made available to MOA parties?

RESPONSE:

Literature and data base reviews (including reviews of the deposition materials) are being utilized to develop details on the Army spills. In addition, onsite reconnaissance (to look for physical evidence of the spills) and discussions with personnel who were present at RMA during the time period when the alleged spills occurred have been conducted as an aid in proper location of Task 24 borings. The sources of information are cited in Section 10.0, References. Pertinent information gathered from the literature review and other sources will be summarized in the Contamination Assessment Report that will be prepared for the Army spill sites, and will be cited in the "References" portion of the report. The report will be made available to the MOA parties in the same manner as reports prepared under other tasks have been made available.

9. COMMENT:

Page 3-2, Spill Site Number 1: The length of rail track north of Building 511 warrants making an additional boring at this site.

RESPONSE:

This spill area is approximately 25 x 150 feet. A single boring is adequate to investigate this site. A Task 2 boring (Phase I) was drilled at this location. The substance allegedly spilled in this vicinity was toluene (a Phase I target compound). No volatile or semivolatile target compounds were detected in the Phase I boring at this location. Therefore, another boring and additional analyses are not warranted.

10. COMMENT:

Page 3-5, Spill Site Number 2: Boring 1 should be located more centrally to the three pits.

RESPONSE:

As stated in the text on page 3-5, Boring 1 is a boring to the water table (anticipated to be at 20 feet in this area) that has been placed downgradient from the former M-1 settling basins to detect whether leakage from the basins may have occurred. This boring was located after a field reconnaissance to determine surface drainage and slope conditions and consideration of groundwater flow direction in this area. The boring was located at the point, based on the above considerations, where any leakage or flow from the basins into the soil column would be most likely detected.

11. COMMENT:

Page 3-10, Spill Site Number 5: Three borings are inadequate for the size and scope of this site. Other Task 2 borings in this site area were not analyzed for Army surety degradation products and therefore are not suitable substitutes for borings in Task 24. Inorganic arsenic and mercury should be added to the list of analytes at this site.

RESPONSE:

A total of 14 Task 2 borings were drilled within the boundary of possible Spill Site Number 5. The Task 2 borings in this area were analyzed for inorganic arsenic and mercury, two indicators of potential Lewisite and associated breakdown product contamination. In addition, three Task 24 bores and one South Plants Regional Study bore are planned for this area, for a total of 17 borings within the boundary of this potential spill area. This is adequate coverage of the area, and additional Task 24 bores will not be proposed.

Inorganic arsenic and mercury have been added to the list of analytes for both the Task 24 bores and the South Plants Regional Study bore. In addition, though this area was thought to be a Lewisite contamination area, information has been provided that indicates that mustard may also have been produced in this area. As a consequence, the Task 24 borings will be sampled and analyzed for thiodiglycol and chloroacetic acid. All past samples were analyzed for semivolatiles, which include dithiane and oxathiane, additional mustard breakdown products.

12. COMMENT:

Page 3-13, Spill Site Number 6: The depth of the borings should be increased beyond 5 feet. It is recommended that the depth of Borings 14 and 15 be ten feet and Boring 10 should be to the water table. Include inorganic arsenic and mercury for analysis at Borings 14 and 15.

RESPONSE:

As the exact nature and locations of any spills in this area have not been defined, the five-foot borings have been placed in a drainage where any such spilled substances would most likely have collected. As any spills or contamination in this area would have been surface spills, evidence of such spills, if detectable at all, would be most likely to be found in the uppermost portions of the soils column. Inorganic arsenic will be included as an analyte for borings 14 and 15, and both inorganic arsenic and inorganic mercury are included as analytes for boring 10. In addition, as discussed in text on page 3-13, thiodiglycol and chloroacetic acid have been added as analytes for all three borings, as the history of the area indicates that this area was utilized for mustard production.

13. COMMENT:

Page 3-16, Figure 24-8: The depth of borings 16 and 17 should be 20 feet, not 10 feet, per the text.

RESPONSE:

The text is correct; the figure will be modified to indicate that the depth of the borings will be 20 feet.

14. COMMENT:

Page 3-21, Spill Site Number 10: Does the reference at the end of the second sentence mean that only Shell has researched this site? How does the standard suite of Phase I analytes compare to the type of pesticides and other products the Army stored in this area? Recommend boring 45 be half way to the water table and boring 38 be to the water table.

RESPONSE:

The reference at the end of the second sentence means that the spill site number was taken from the 1985 Shell letter summarizing spills at RMA. The exact nature of substances stored (and who stored them) at Building 753 is not known. No references were found indicating that any substances stored in Building 753 were spilled. Thus, the two borings planned for Spill Site number 10 have been placed in locations, based upon field reconnaissance, where any substance which may have been spilled would most likely be found. One boring has been placed in a low spot north of Building 753; if spills did occur in and around the building, runoff from the area would have collected in this area. Another boring has been placed in a fenced area east of the building to determine whether the fenced area was utilized for storage, and if so, if spills occurred in this area. As any spills in the area would have been to the surface, any substances detectable in the soils in the area would be most likely found in the upper portion of the soil column, so five-foot bores and sampling intervals would be most likely to detect any spilled substance if such substances are present.

15. COMMENT:

Page 3-23, Spill Site Number 11: Soil gas sampling should be performed around the building.

RESPONSE:

As stated in the text, evidence of possible contamination within Building 471 will be rearched as part of the structures survey. If research indicates with greater specificity areas outside the building where spills may have occurred, borings will be placed as necessary to identify the nature and extent of soils contamination that may have resulted from any such spill. As benzene in the shallow groundwater in the vicinity of this spill site would tend to obscure any benzene detected through soil gas monitoring, soil gas monitoring is not proposed as a method of delineating this spill area.

16. COMMENT:

Page 3-17, Spill Site Number 8: The analytes listed in the table are not consistent with statements in the text above.

RESPONSE:

The text is correct; the Phase I analytes were inadvertently left off the summary table. Boring 9 will be analyzed for the standard suite of Phase I analytes as well as for thiodiglycol and chloroacetic acid.

17. COMMENT:

Page 3-27, Spill Site Number 13: Since the suspected releases were arsenic trichloride, all samples should be analyzed for inorganic arsenic. Because of the close proximity of the borings to the silos, it is doubtful that the proposed boring plan will indicate the extent of wind dispersion, particularly since some or many of the releases occurred at elevated levels. The predicted pattern of dispersion should be displayed in Figure 24-13.

RESPONSE:

All planned intervals of borings 22, 23, 28, and 29 will be analyzed for inorganic arsenic. In addition, samples will be sent to the RMA laboratory for analysis for Lewisite and Lewisite Oxide. The borings planned for this site have been located in areas where arsenic compounds are most likely to have been transported by either the wind or by surface runoff. The wind dispersion pattern is not known, but the directions of seasonal prevailing winds, as well as the prevailing direction of surface runoff, are shown on Figure 24-13.

18. COMMENT:

Page 3-32, Spill Site Number 15: In the third paragraph, why is it suggested that the pit may not be sampled? Samples should be taken both above and below the liner.

RESPONSE:

Sampling is proposed for the materials within the pit. However, if the pit has been filled with rubble or similar materials, sampling may not be possible. The third paragraph indicates that, in the event that materials within the pit cannot be sampled, the first sampling interval will be the one-foot interval immediately below the concrete/lead liner of the pit.

19. COMMENT:

Page 3-35, Spill Site Number 16: Because of the known discharge of contaminants into an unlined ditch over an extended time period, more than one boring is recommended.

RESPONSE:

As two Task 24 borings are also planned for Spill Site Number 17, which is north of Spill Site Number 16 and a part of the same ditch system, additional borings are not required.

20. COMMENT:

Page 3-36, Figure 24-16: Possible Army Spill Site 15 mislabeled. It should be Site 17.

RESPONSE:

This correction will be made on Figure 24-16.

21. COMMENT:

Page 3-37, Spill Site Number 17: Text should explain how contaminants which are not in the "standard suite of Phase I analytes" will be investigated.

RESPONSE:

As stated in the text on page 3-37 and in the summary table on page 3-38, all intervals of both planned borings at this site will be analyzed for thiodiglycol and chloroacetic acid in addition to the standard suite of Phase I analytes. The borings will also be analyzed for inorganic arsenic and inorganic mercury, and samples will be sent to the RMA laboratory for analysis for Lewisite and Lewisite Oxide. Other compounds will be tentatively identified in the analysis of the GC/MS results as non-targets.

22. COMMENT:

Page 3-47, Spill Site Number 20: Anticipated water table level at this site is 10 feet but is 20 feet at adjacent Site Number 7?

RESPONSE:

The borings for Spill Site Number 20 are in a low area and a ditch, and the borings proposed for Spill Site Number 7 are in an area that has been filled and paved. Thus, though the water table in both areas is likely to be at the same absolute elevation, the distance from ground surface to the water table differs at both sites. At least one boring will be taken to the water table, regardless of the depth at which the water table is encountered. The anticipated depths from ground surface to the water table are provided so that the appropriate number of samples and planned sampling intervals can be identified.

23. COMMENT:

Page 3-50, Spill Site Number 22: Unless it can be established that the drains were connected to the chemical sewer system, samples should be analyzed at the likely discharge points of the drains.

RESPONSE:

As stated in the text on page 3-50, the status of connections to the chemical sewer system will be researched as part of the structures survey. If that research indicates that the drains were not connected to the chemical sewer system, a decision will be made whether (and where) to place borings.

24. COMMENT:

Page 3-52, Spill Site Number 24: The Task 2 borings are not close enough to Building 534 to substitute for Task 24 borings. Note however that Shell Spill Site Boring 0601 located north of Building 534 contained an elevated mercury concentration in the 0.6-1.6 foot sample interval. Additional borings around Building 534 should be made in Task 24.

RESPONSE:

As stated in the text on page 3-52, evidence of contamination within buildings (including Building 534) will be researched as a part of the structures survey. If information is found indicating that mercury spills external to the building occurred, additional borings will be placed as appropriate to locate and evaluate any contamination that may have resulted. Shell's records do not indicate that it handled acetylene in this area.

25. COMMENT:

Page 3-54, Spill Site Number 25: Army drawing P6-66-1 (January 15, 1951) indicates that "phossy water" was also discharged to a ditch east of Building 413.

RESPONSE:

The ditch east of Building 413 is shown at the extreme left of Figure 24-22, and is part of the ditch system to the south of Buildings 522A, 522, and 523. Two borings are being placed in this ditch system as a part of the Task 24 drilling program.

26. COMMENT:

Page 3-64, Spill Site Number 31: As stated in its December 22, 1986 letter concerning the South Plants Regional Study, Shell believes that a more thorough investigation should be made of areas along railroad sidings near warehouses and manufacturing areas.

RESPONSE:

A substantial number of borings have already been drilled or are planned for areas along railroad sidings near warehouses and manufacturing areas. For example, within the South Plants, there are 14 borings along railroad tracks proposed as a part of the South Plants Regional Study; 18 borings along railroad tracks/sidings drilled as a part of the Phase I Shell spill site study under Task 2; 8 additional borings along railroad tracks proposed as a part of the Task 24 drilling program; and 4 borings drilled as a part of the Phase I activities under the Task 2 sites drilling program and the uncontaminated section 1 and 2 drilling program, for a total of 44 borings drilled or planned along railroad tracks in the South Plants area alone.

27. COMMENT:

Page 3-65, Spill Site Number 32: Was the waste pit installed when hydrazine was first handled on the RMA? Has any water from the hydrazine tank cars been drained on the ground? Did the Phase I borings investigate the unloading area for hydrazine? If not, they should be investigated.

RESPONSE:

The installation date for the waste pit is unknown. Figure 24-25 indicates that five borings were placed along the railroad track in and near the hydrazine facility during the Task 11 drilling program. One of these borings is near the loading dock facility in the western portion of the hydrazine facility. As potential soil contamination in these areas was investigated under Task 11, no additional bores are proposed for this facility under Task 24.

28. COMMENT:

Page 3-71, Spill Site Number 37: Building 742 currently has a sign on the west end which indicates the facility has been used as a pesticide storage facility. Therefore, the entrances and loading docks should be checked for evidence of pesticides contamination during the building investigation. If pesticides were formulated in this facility, this should be mentioned and the possibility of spills investigated. The pesticides the Army handled on the RMA should be included, particularly the ones not on the Phase I analyte list.

RESPONSE:

The only pesticide referenced in the literature as being stored in Building 742 is a 14-gallon metal drum of 85 percent Naled (Dibrom, or 1-2-dibromo-2,2-dichloroethyl dimethyl phosphate), an organophosphorous pesticide. Though no specific references were found to other pesticides, the history of use for the building indicates that a portion of the building has been used to store pesticides. No information is available on whether these substances have been spilled. The Army did not formulate pesticide in the building.

The potential for spills or other contamination due to the storage of pesticides will be evaluated during the structures survey. If evidence is found concerning spills of these substances outside the confines of the building, additional bores will be placed and additional analyses will be planned as appropriate.

29. COMMENT:

Page 3-77, Spill Site Number 40: The sampling of the trenches has been already commented on in Comment 4. It is recommended that samples be taken from deeper than 4-6 inches since the mustard or degradation products may have evaporated from the shallow depths over the years.

RESPONSE:

See the response to Comment 4. It is unlikely that the mustard would evaporate, as the distilled mustard is a thick, oily substance that would tend to bind with the soil particles. Also, as is noted in the response to Comment 4, a boring is being placed at this site and is being analyzed for thiodiglycol and chloroacetic acid, so any downward migration of mustard breakdown products can be identified.

30. COMMENT:

Page 3-79, Spill Site Number 41: Will the standard suite of Phase I analytes detect the chemicals which may have been released?

RESPONSE:

Yes.

31. COMMENT:

Page 3-90, paragraph 3.4.4: Where is the source of offsite uncontaminated water?

RESPONSE:

In instances where unchlorinated water is required, a filtering setup is now available within the contractor's facilities at RMA to filter chlorinated Denver city water onsite to remove the chlorine.

32. COMMENT:

Page 3-91, paragraph 3.5.3: Are magnetic materials which are detected going to be investigated as a part of this program? If not, when will they be investigated?

RESPONSE:

As stated in the text on page 3-91, the purpose of the magnetometer surveys is to identify buried metal objects that may be components of the utilities systems so that these items can be avoided during drilling, and, in limited instances, to identify potential UXOs. As the purpose of the surveys is avoidance, not investigation, these items will not be excavated and inspected as a part of the Task 24 program. Buried utilities (for example, the sewer and process water systems) are being investigated under Task 10. As stated in the text, UXOs are not anticipated within areas covered under the Task 24 drilling program, but if potential UXOs are identified during geophysical surveys, the assistance of the U.S. Army Technical Escort Unit will be sought for evaluating and removing these items.

33. COMMENT:

Page 4-1: The second paragraph does not appear to be consistent with other sections of the plan. What is meant by target analytes? Will all samples be screened for non-target analyses, e.g., on samples where only Army degradation products are specified for analysis?

RESPONSE:

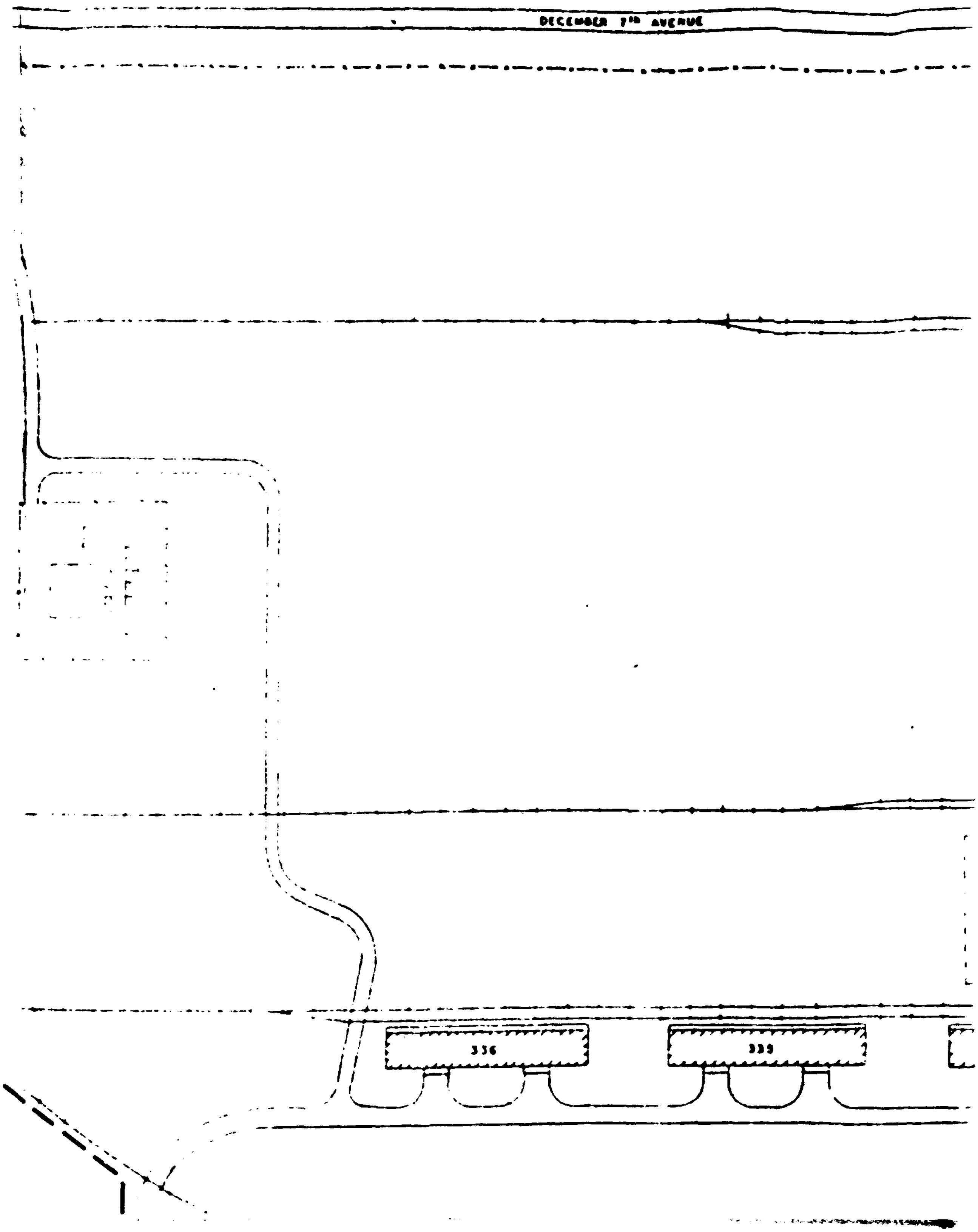
"Target analytes" are the Phase I analytes identified on Table 24-3. These analytes are also referred to as the Phase I suite of analytes in various portions of the Technical Plan. A GC/MS scan for non-target analytes will be done for the volatile and semivolatile organics, consistent with procedures used for Task 2 Phase I analyses. In instances where only Army degradation products are specified for analyses, a GC/MS scan for non-target compounds will not be done.

34. COMMENT:

Page 4-13, paragraph 4.3.2: Control points should not be located in areas of potential contamination. The control points should be located in "clean" areas in order to obtain uncontaminated background data.

RESPONSE:

The control points for the soil gas survey were chosen as representative of South Plants background levels, and are not representative of totally uncontaminated areas. The reason for choosing South Plants background points is so that any general South Plants soil contamination "noise" can be screened out of the analysis, and so that any incremental increase potentially attributable to spills can be identified. The soil gas survey proposed as a part of the Task 24 program will be utilized as a "focusing" mechanism to aid in the placement of bores for spill areas where the spill is not well defined and where the spilled substances are suspected to be compounds that can be detected using soil gas methods.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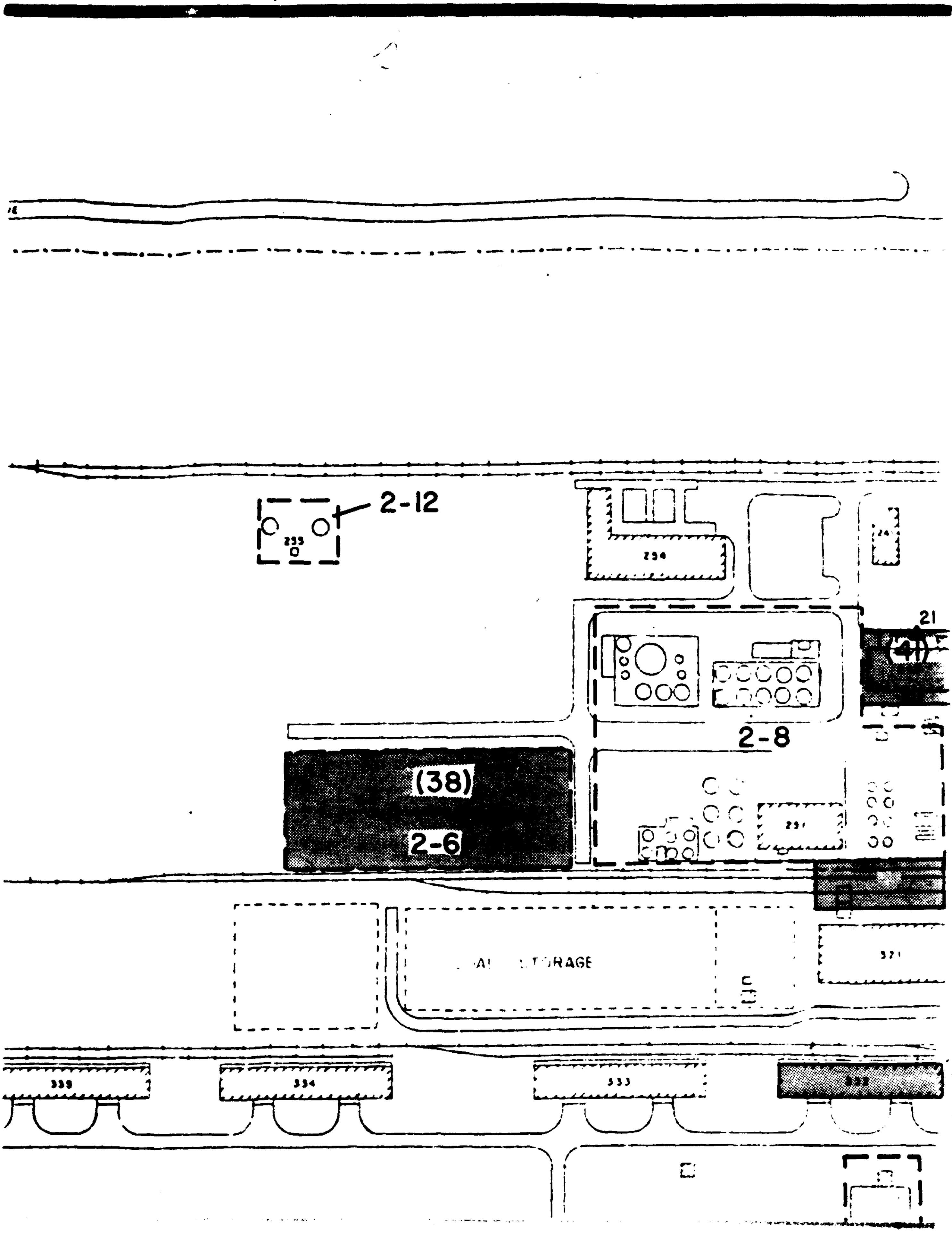
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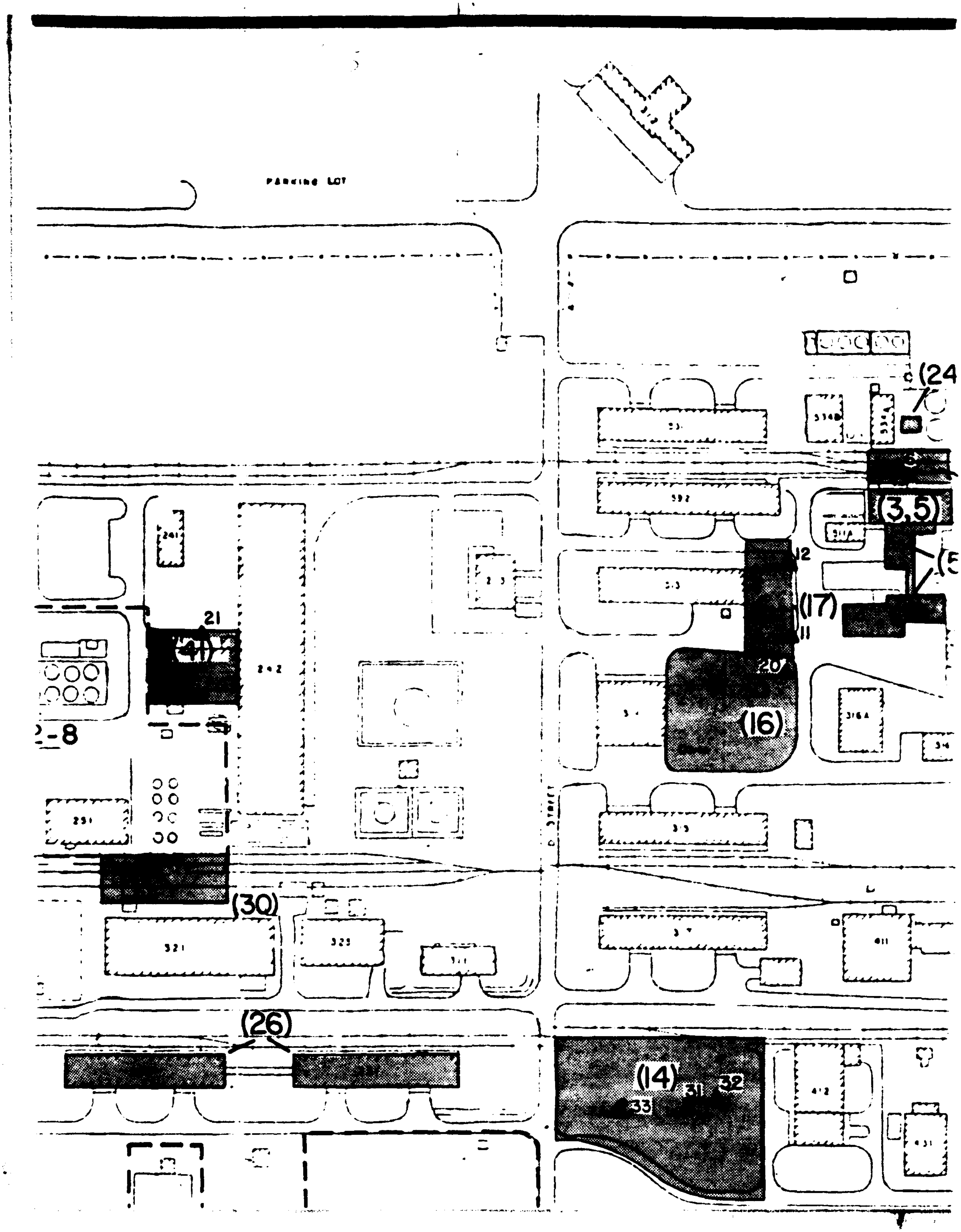
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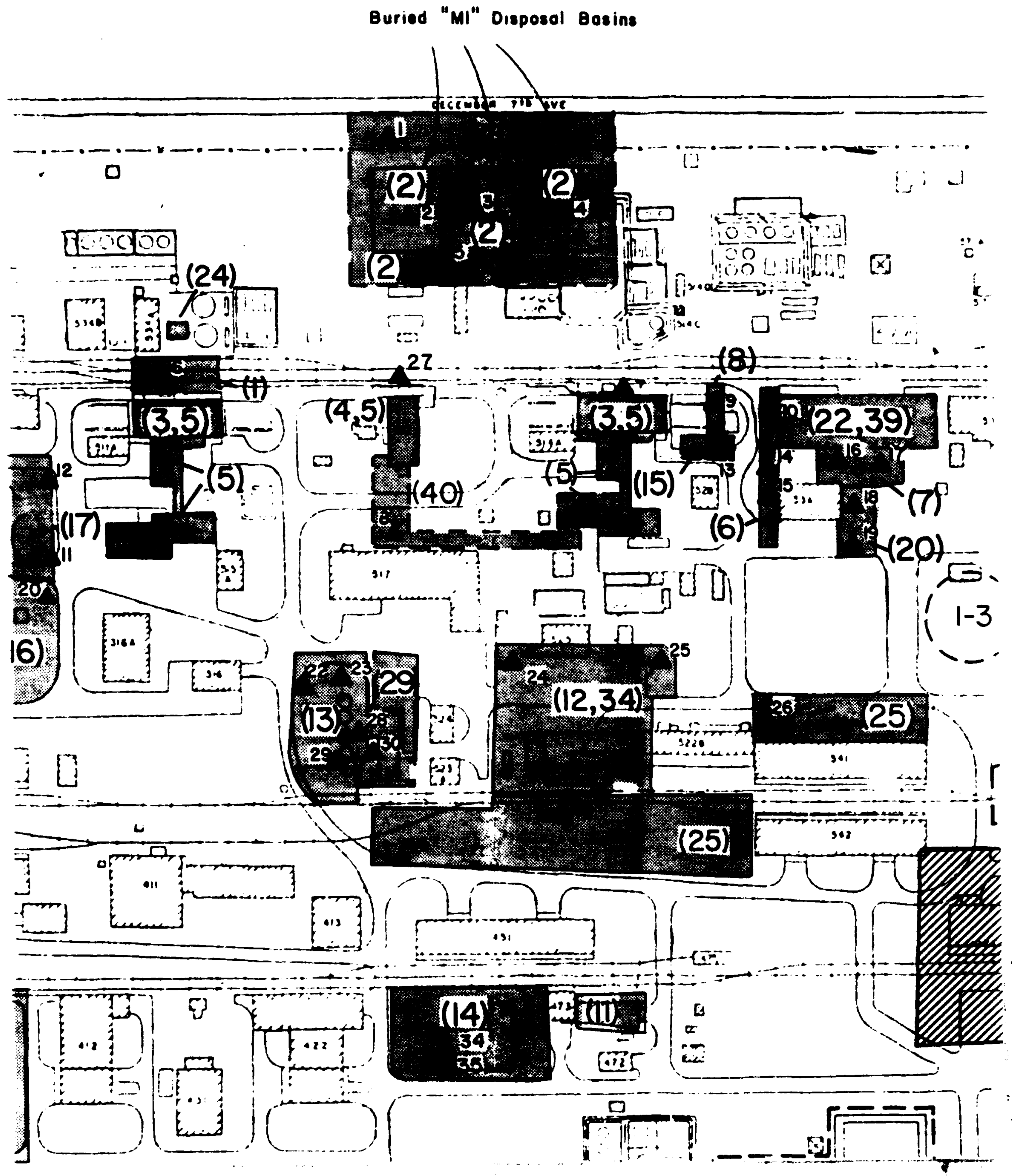
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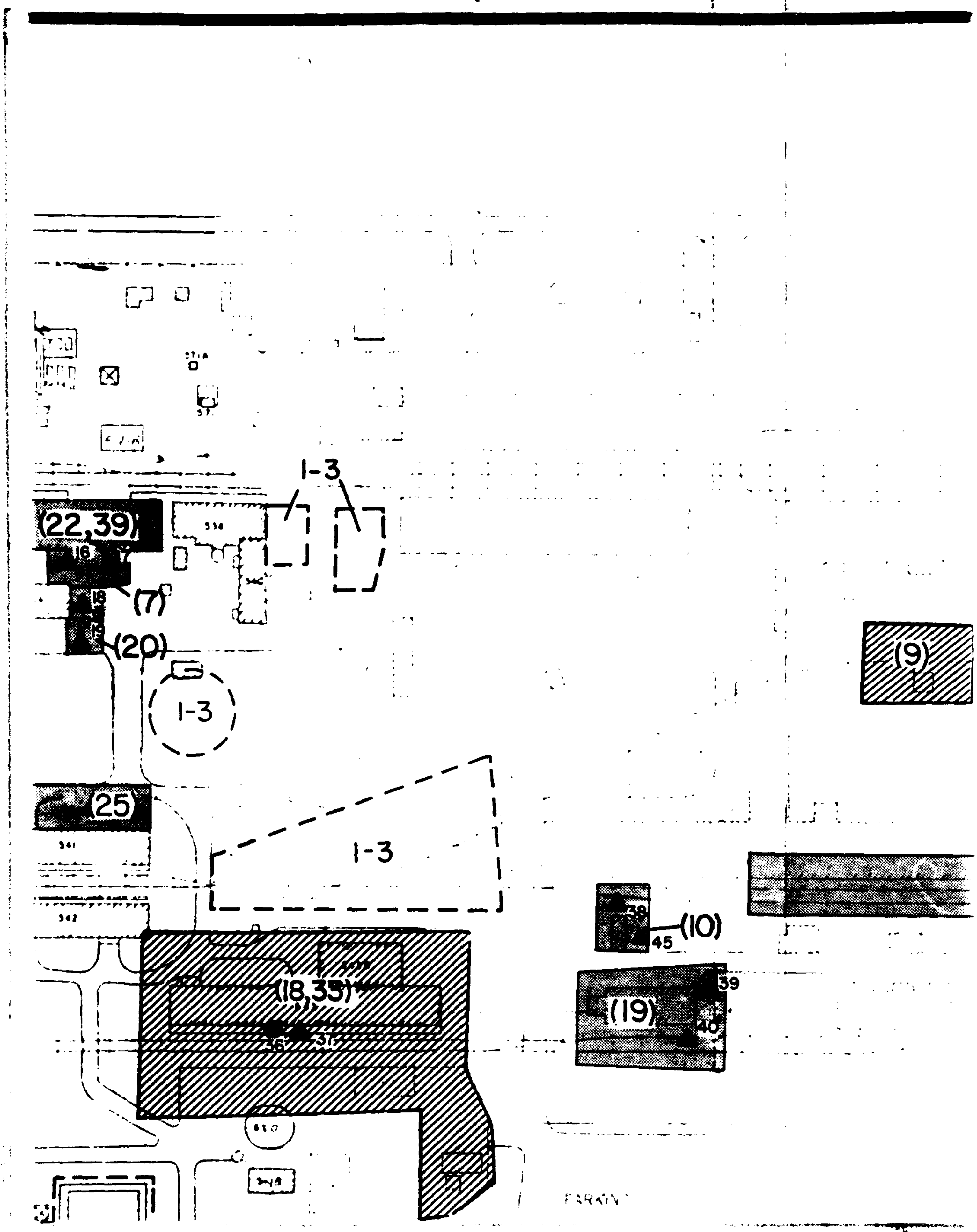

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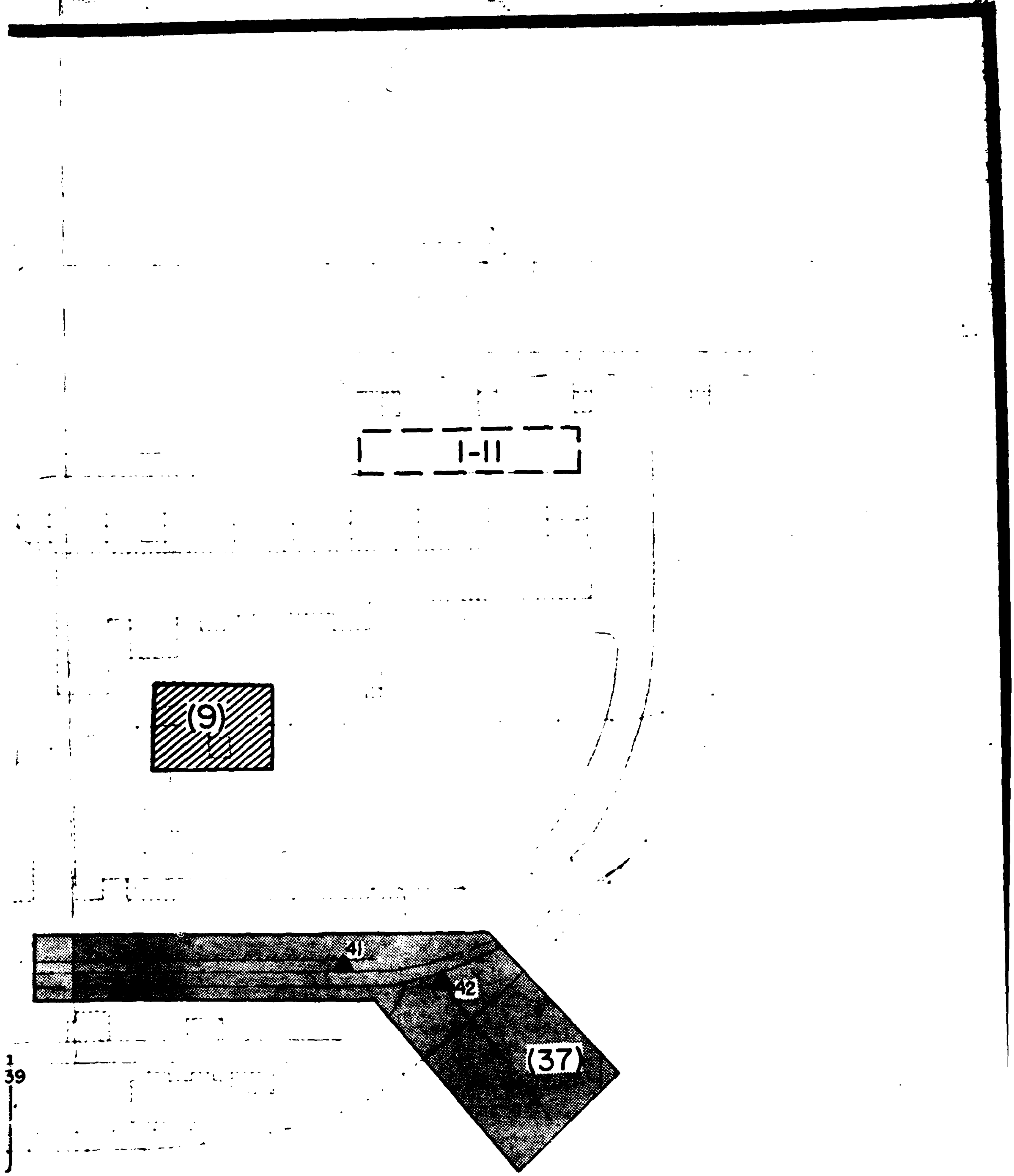

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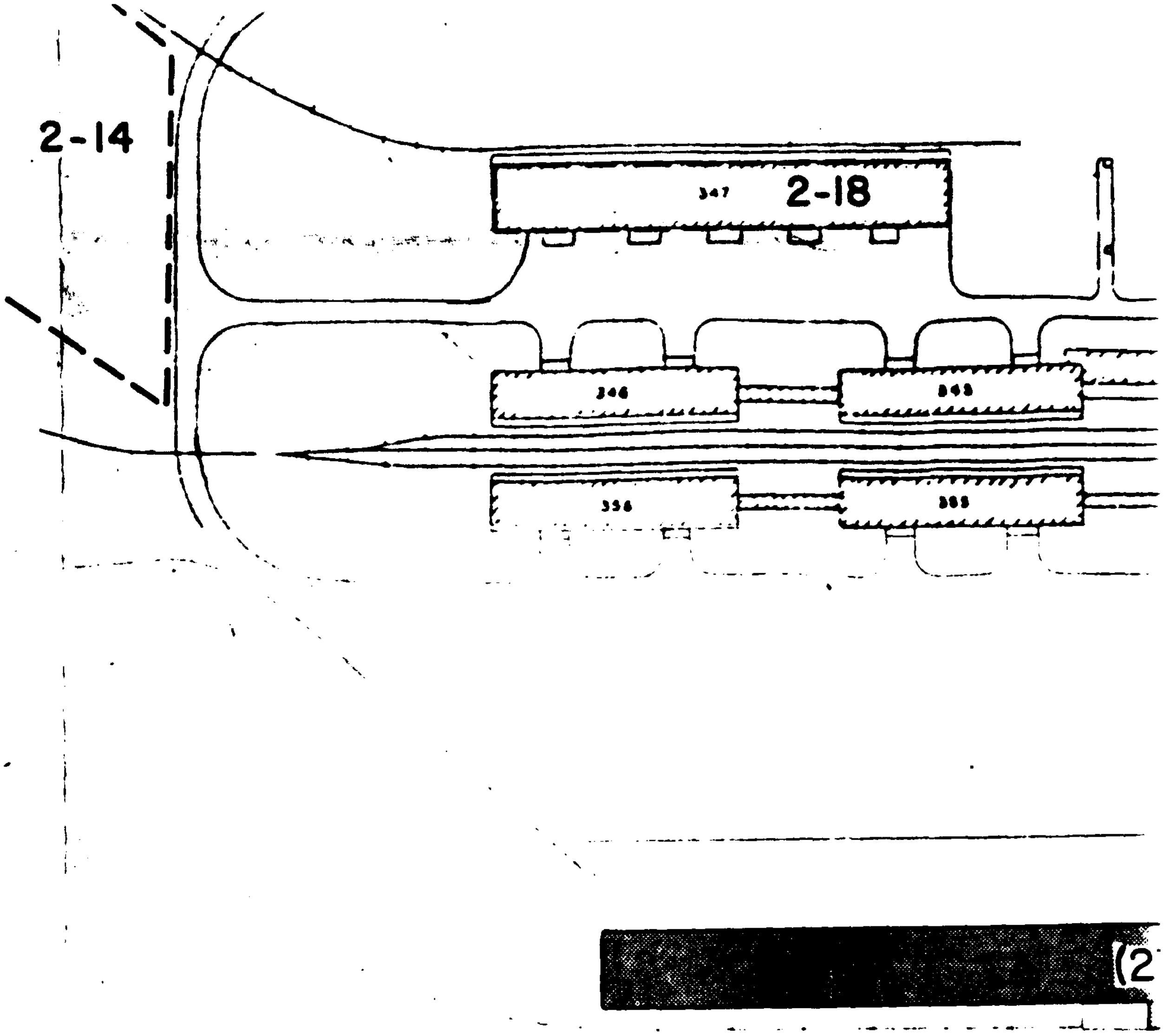
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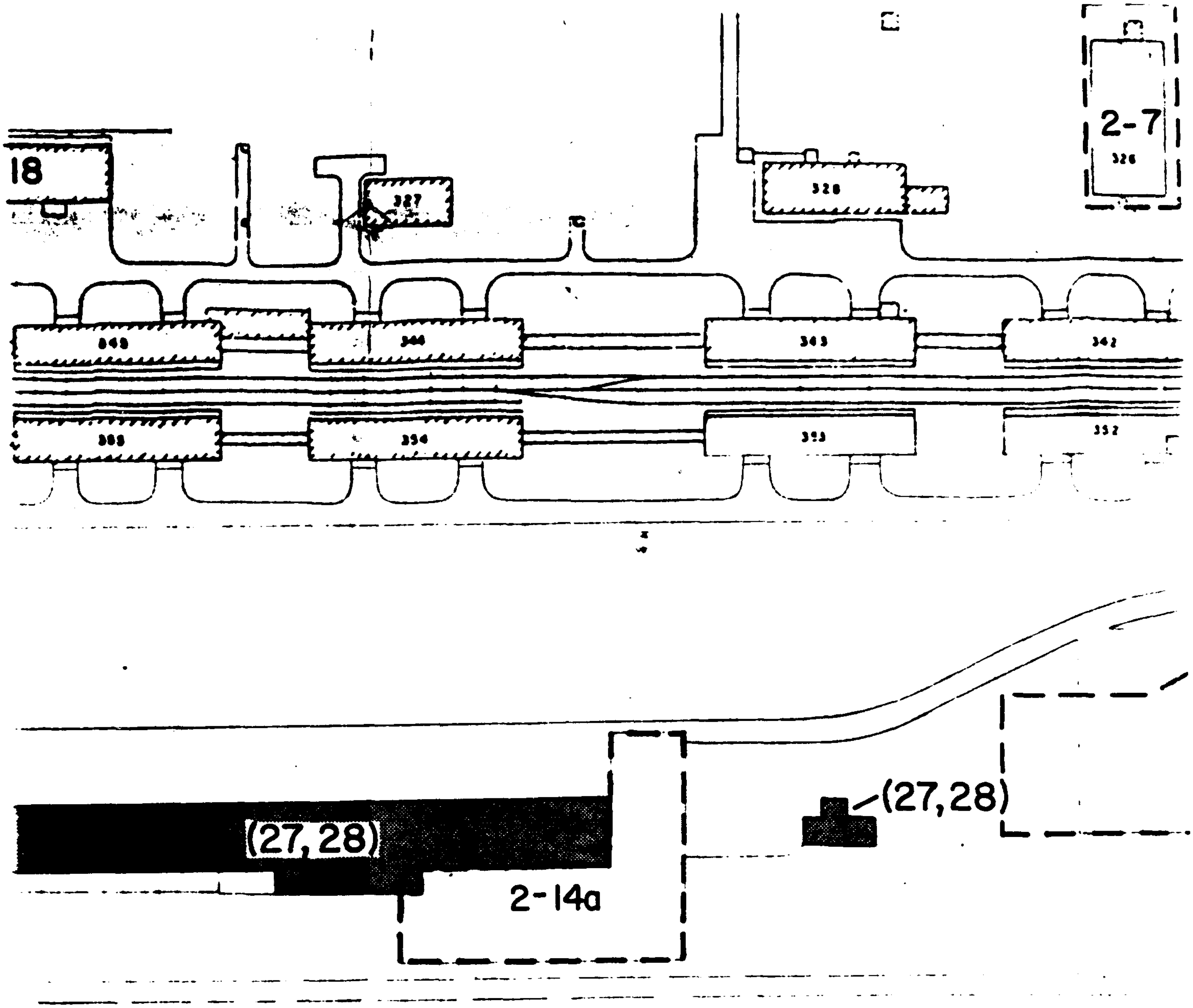

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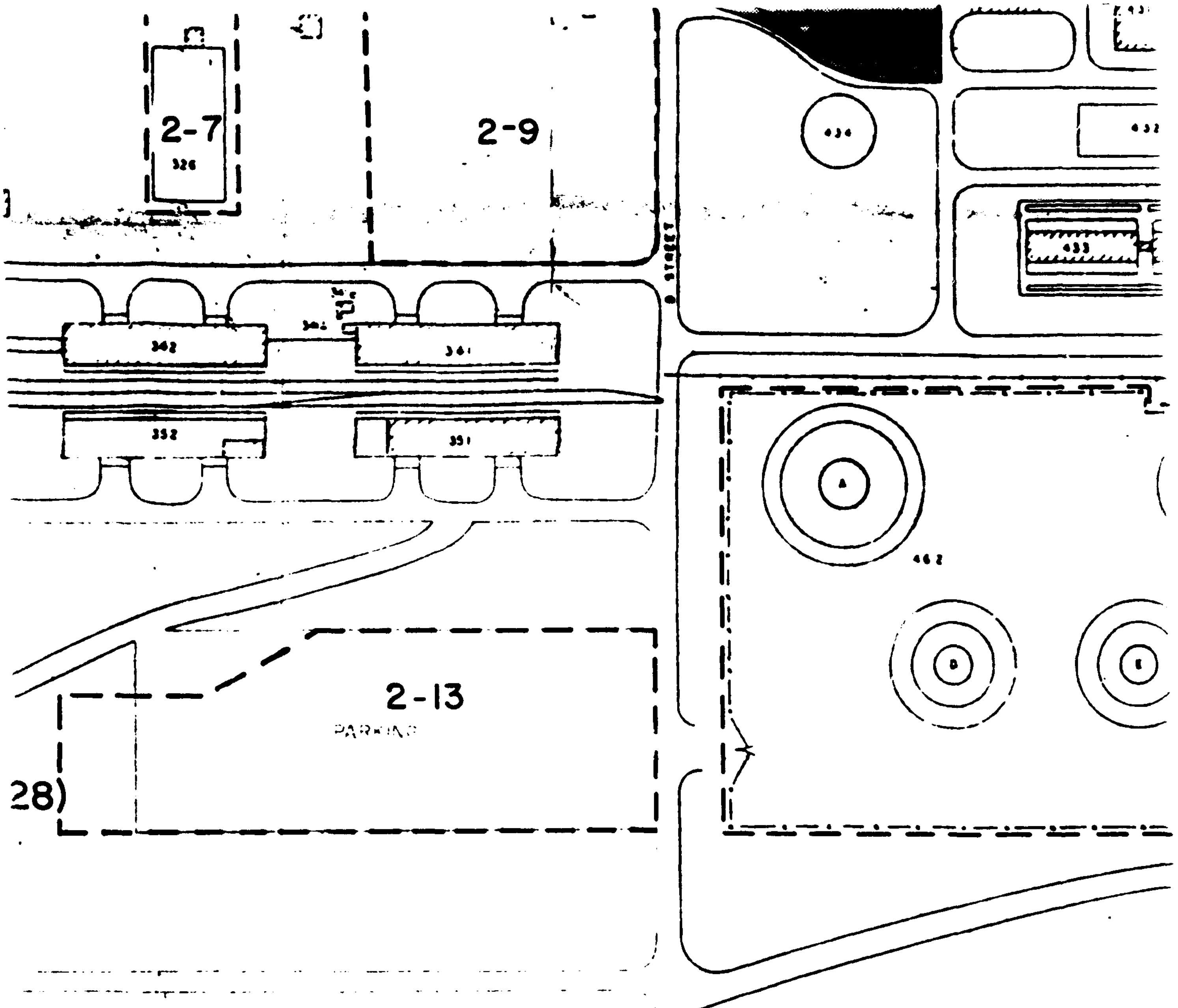

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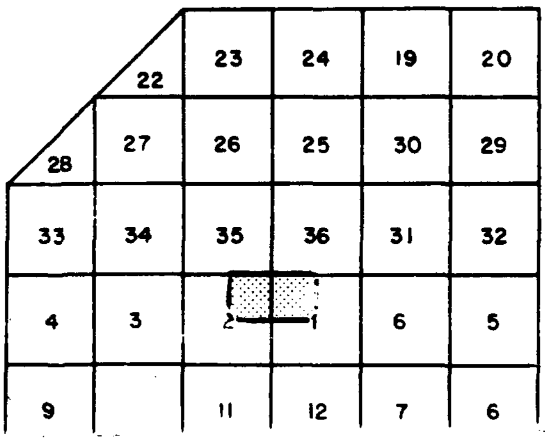
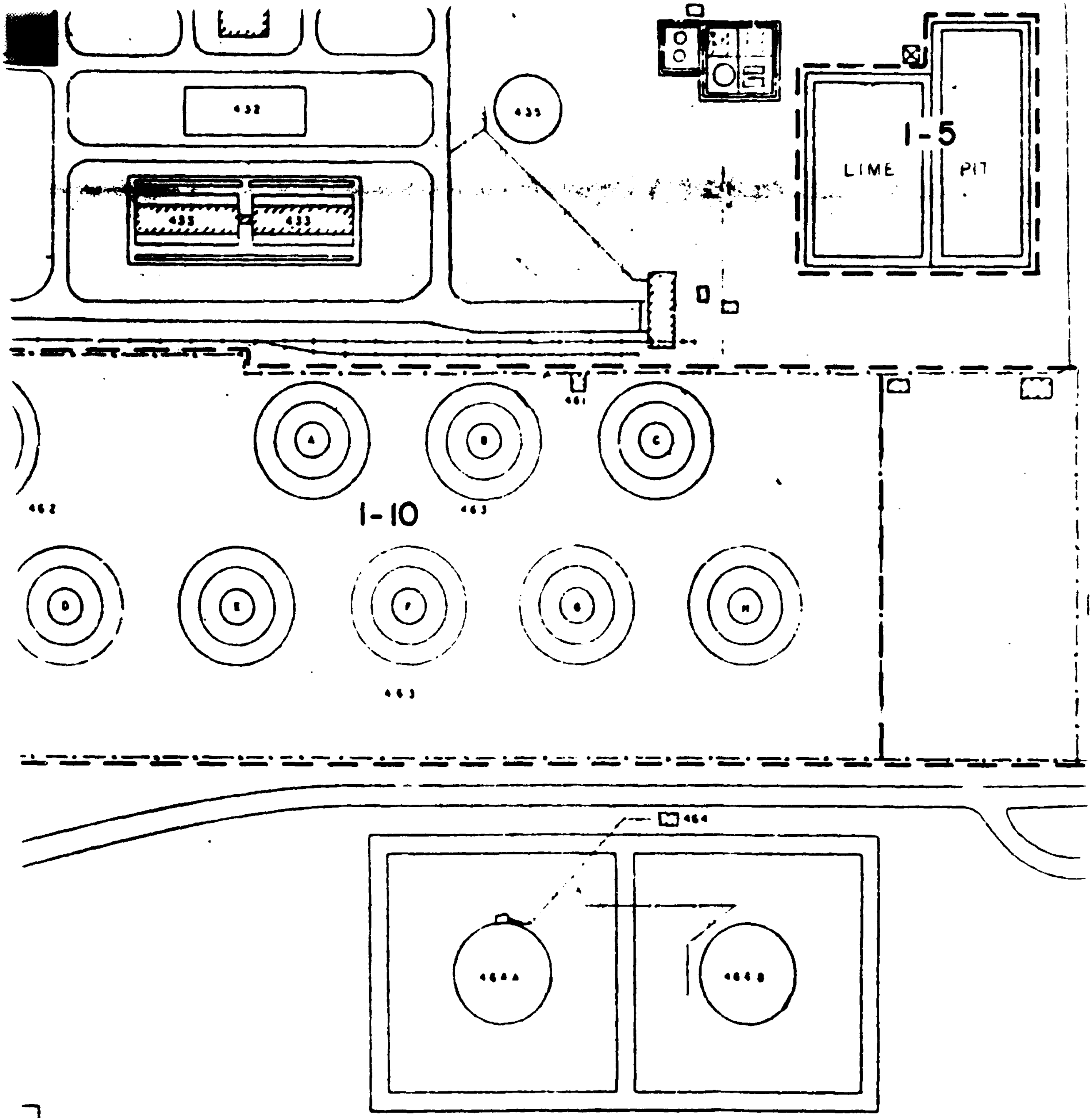
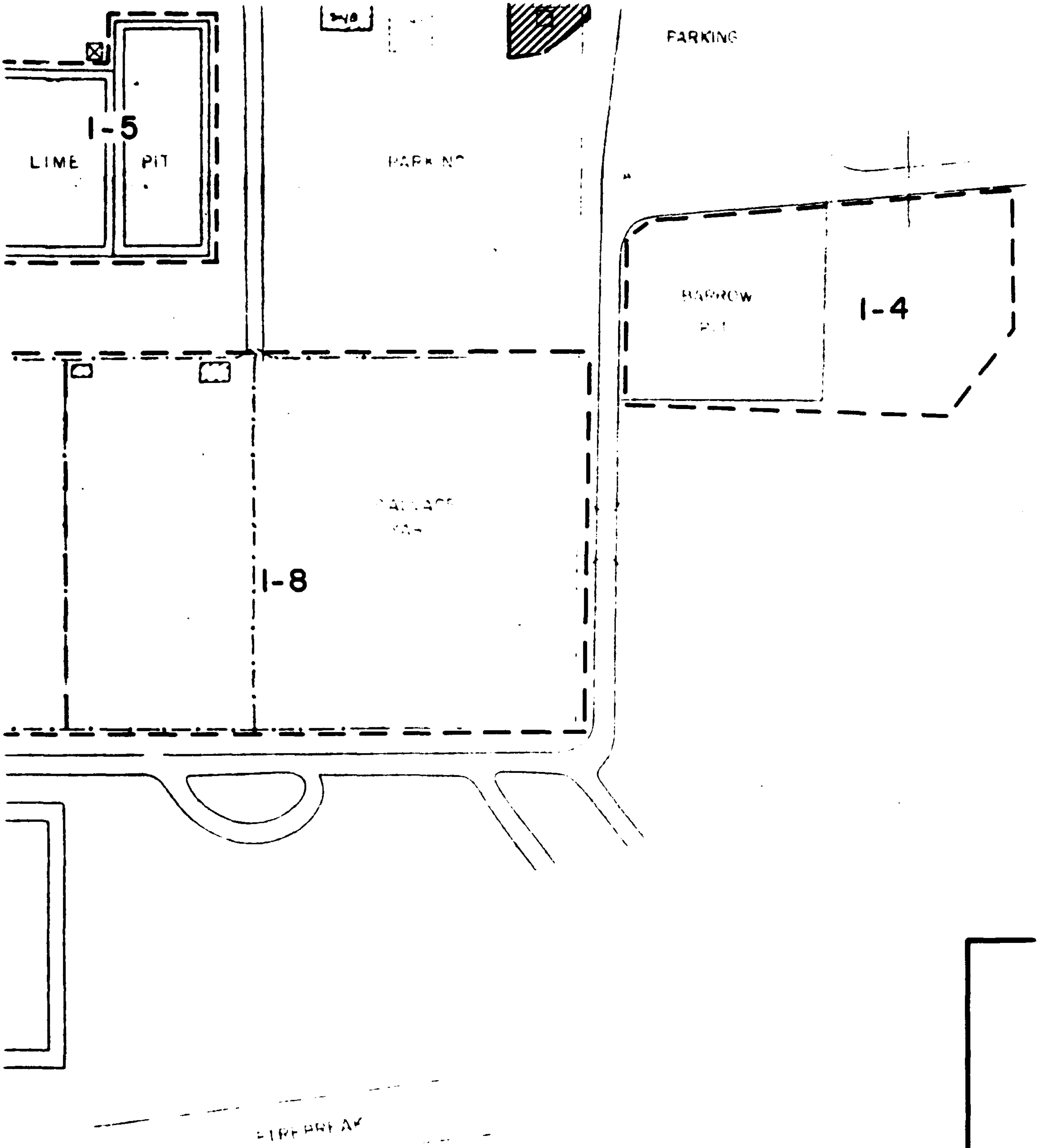




▲ **Proposed Phase I Army Spill Sites Borings**

● **Proposed Phase I Grab Sample**

(3) **Possible Spill Locations**



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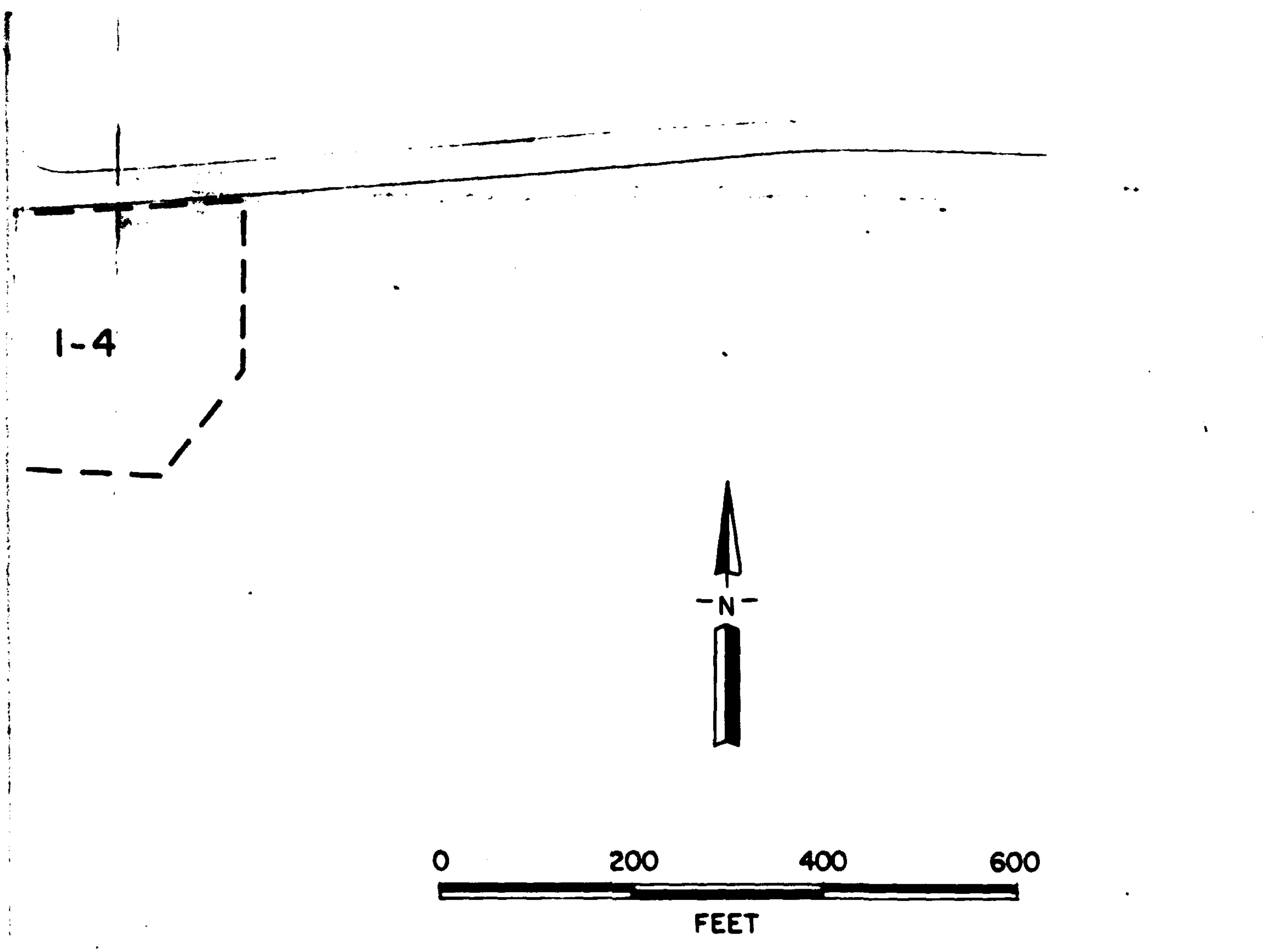
Portions of Sites Examined Under Separate Tasks

Portions of Sites Investigated as Possible



Prepared for:

Program Manager's Office for

Rocky Mountain Arsenal Cleanup

Aberdeen Proving Ground, Maryland

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FIGURE 24-2

Army Spill Sites and
Proposed Phase I Borings and Sampling Plan

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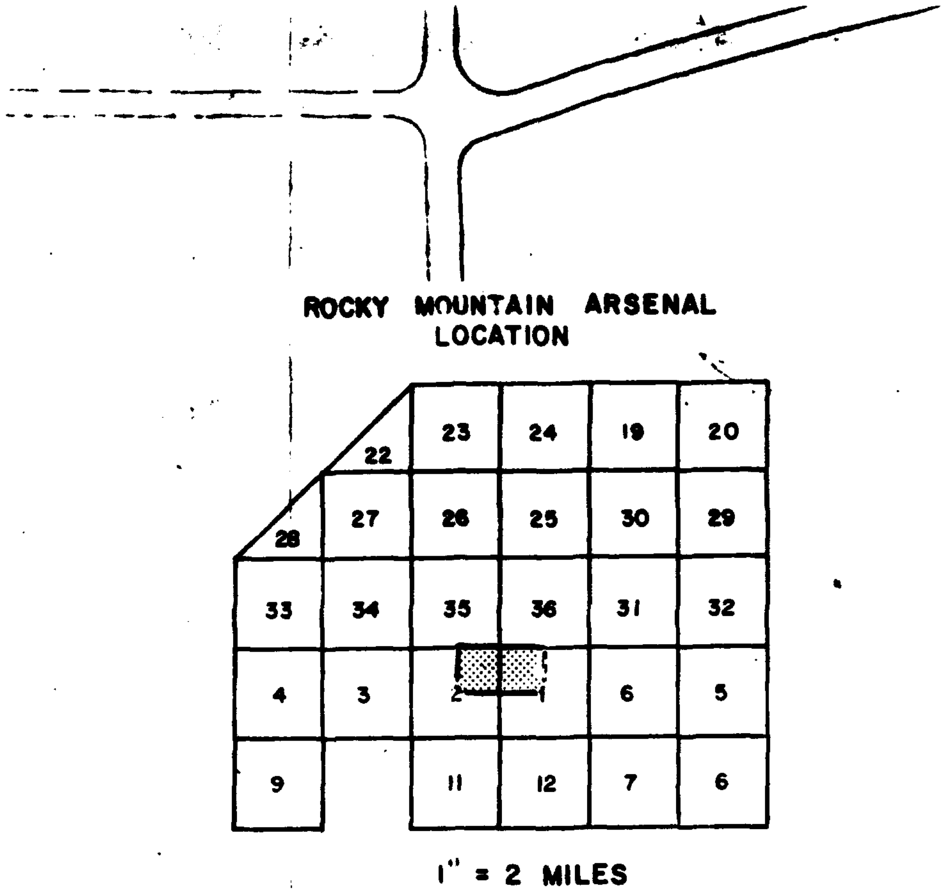

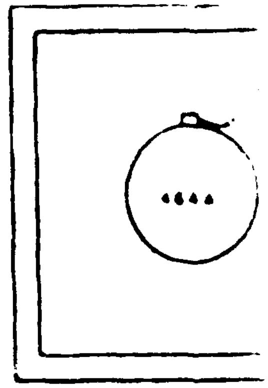

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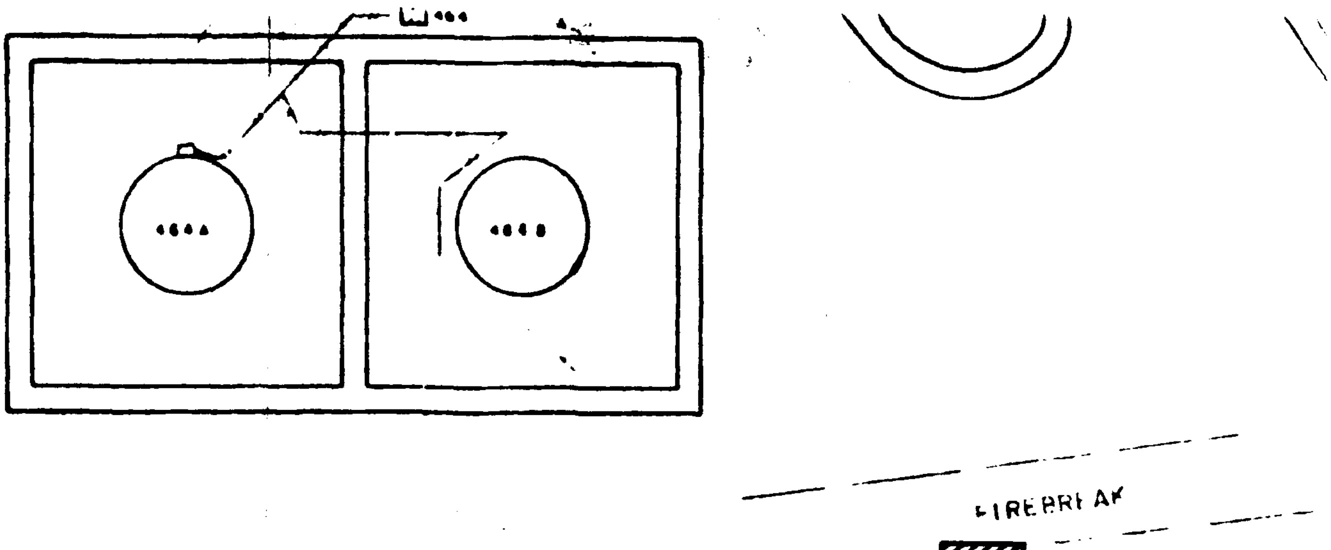

▲ **Proposed Phase I Army Spill Sites Borings**

● **Proposed Phase I Grab Sample**

(3) **Possible Spill Locations**

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Area Designated for Soil Gas Investigation

Portions of Sites Examined Under Separate Tasks

Portions of Sites Investigated as Possible Army Spill Locations

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FIGURE 2

Army Spill

Proposed Pl

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Prepared by

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Prepared for:

Program Manager's Office for

Rocky Mountain Arsenal Cleanup

Aberdeen Proving Ground, Maryland

FIGURE 24-2

Army Spill Sites and
Proposed Phase I Borings and Sampling Plan

Rocky Mountain Arsenal, Task 24

Prepared by: Ebasco Services Incorporated